THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
The Burning Question	133
High Electromotive Force	135
Some Notes on Single-phase Motors (*illustrated*) (*continued*) ...	136
Small Lighting Plants	137
Comparative Cost of Steam and Electric Power...	137
An Electrical Hypothesis for the Solar and Planetary Systems, and Some of their Associated Phenomena.—II. (*illustrated*)	138
The Institution of Electrical Engineers	141
Legal	142
Correspondence:—	
Refuse Destructors	144
Is an Electric Traction Engine Subjected to Shocks, or is it Not?—Raworth *v* Emery	146
Electro-motors and Fire Office Rules	147
Business Notices, &c.	147
Notes	151
City Notes	154
Traffic Receipts	156
Share List of Electrical Companies	157
The Institution of Electrical Engineers	158
The Physical Society...	160
Notes on the Electro-chemical Treatment of Auriferous Ores ...	161
A Survey of the Possibilities of Electric Heating and Cooking	162
The Pacific Cable	163
Electric Lighting and Dust Destructors for Gloucester... ...	164
The Leyton Destructors	165
A New Induction Coil (*illustrated*)	165
The Telegraph Troubles (*continued*)	166
Ideal Circuit Breaker (*illustrated*)	167
New Patents and Abstracts of Published Specifications ...	168

THE

UNIVERSAL ELECTRICAL DIRECTORY

1898

Edition

READY IN A FEW DAYS.

H. ALABASTER, GATEHOUSE & CO.

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THE BURNING QUESTION.

No branch of business connected directly or remotely with the electrical industry is at present showing more activity than that concerned with the much-debated dust destructor. We were witnesses of and participators in an enterprising event on the 27th inst., when some 200 engineers, surveyors, chairman of committees, and other influential gentlemen, from all parts of England, inspected the dust destructor at Leyton. The guests came by invitation of the Urban District Council, but the syndicate that built the destructor was very much in evidence. "The voice was the voice of Jacob, but the hands were the hands of Esau."

That veteran sanitarian and eminent engineer, Captain Sir Douglas Galton, R.E., was the "lion" of the occasion, just as Lord Kelvin was the "lion" of a similar function held at Shoreditch some time ago. Each guest was provided with a neat little brochure having a picture of the works as a frontispiece. The brochure first describes briefly the problem and afterwards the solution. In our opinion the problem is insufficiently set forth, and the statement of the solution gives as a sole result the total amount of refuse and sewage sludge burnt in tons during the year 1897, and as a deduction therefrom the amount burnt per cell per 24 hours.

The destructor is next described and the two 96-horse-power water-tube boilers in connection therewith. It is stated that the temperature of the combustion chamber frequently reaches 2,500° Fahr. Favourable opinions of Sir Douglas Fox, C.E., and Mr. Francis Fox, C.E., are next given, and also an extract from the report of Mr. William Dawson, C.E., engineer and surveyor of the Urban District Council. Finally, the Council state that their reason for putting these facts before their visitors is their desire to share with other municipal authorities any ideas that may prove of assistance and value to them. The facts referred to should also prove of considerable assistance and value to the enterprising makers of the destructor, the Beaman & Deas Syndicate; and we may say that we welcome this attitude of a local authority in assisting a firm that has, in their opinion, served them well, by joining with them in such a function as that of last Thursday. Too often local authorities discourage any attempts at legitimate advertising undertaken by the firms whom they employ.

But when we come to criticism from an engineering point of view, we must confess that we think far more is embodied in the problem than the mere destruction of the refuse and sludge, and as regards its solution, it will be necessary fo us to know what is the cost per ton burnt—for labour, repairs, interest on first cost, and so forth, before we can arrive at a fair judgment. As we have stated before in these columns, we regard the problem as not admitting of a single solution, but it requires first that the apparatus shall work without nuisance, either from smoke or dust; second, that the refuse, or refuse and sludge, shall be completely burnt; third, that the

temperatures shall be high enough to ensure complete combustion with maximum steam raising capacity; and, finally, and most emphatically, that the cost of labour per ton burnt should be as low as possible consistent with fair wages and fair hours of labour to the workmen employed. The brochure is unfortunately quite silent on every one of these points, except as to the temperatures, and deals only with the amount burnt per cell, which we regard as quite a minor consideration. The amount burnt per cell is high, but that is not a special feature of any destructor, as it is simply a question of the strength of blast and the number of men employed. Given a strong enough blast, and a sufficient number of men, a very large amount of refuse can be burnt per square foot of grate per hour, and an instance is on record in which in a destructor of another type, 26·75 tons were burnt in a cell in 24 hours. This was at Leeds, and the figures were published by the Medical Officer of Health, Dr. Spottiswoode Cameron. As regards steam raising, we noticed that the boilers were blowing off at 105 lbs. on the occasion of the "Public Inspection," and 95 I.H.P. was stated to be about the amount of the power daily used. This is approximately about what might be expected, and it may be considered a good result in view of the wet nature of 30 per cent. of the material being burnt. It is, no doubt, somewhat of a feat to burn sewage sludge successfully, while at the same time raising a fair amount of steam; but it is a curious fact that sludge is not difficult to deal with in a destructor, as is proved by the fact that Mr. Jones, C.E., the well-known surveyor of Ealing, has successfully burnt it in a natural-draught low-temperature destructor for many years past, in proportions just about the same as those adopted at Leyton, namely, one-third sludge, and two-thirds refuse. This seems to have escaped the notice of the directors of the Beaman and Deas Syndicate, who state that no destructor has hitherto been capable of destroying wet sewage sludge, but a perusal of the letter from the Ealing surveyor, which will be found in our "Correspondence" columns, may serve to point a moral, if it does not adorn the tale of the "remarkable new departure" at Leyton. The temperature stated in the brochure as attained in the furnace, namely, 2,500° Fahr., is a somewhat fanciful figure. We venture to surmise that no such temperature has ever been accurately measured; but probably somebody has judged it "by eye." It might as well be estimated by "rule of thumb." So far as we know, such a temperature as that has not hitherto been reached in burning ordinary house refuse, much less in burning such wet stuff as sewage sludge. The electric light plant is employed in lighting the works only, and the current is generated by a 3-kilowatt machine. There is, therefore, no fitting opportunity for a further outburst of correspondence in our columns, similar to that which has recently raged around the Shoreditch plant.

While at Leyton we were also presented with the report referred to in the brochure of Sir Douglas and Mr. Francis Fox. This interesting report supplies, to some extent, the information omitted from the brochure. The results given are based upon a 12 hours' trial and must be judged accordingly. The sludge was found to average nearly 65 per cent. of water. We may note that the term "pressed sludge" is used, but it is very questionable whether the expression can be legitimately applied to sludge which contains so large a percentage of water, and, further, it may be pointed out here that this water requires only to be warmed to a temperature of 212° in order to send it up the chimney, leaving a comparatively small amount of dry material to be dealt with.

In spite of this the residuum from the refuse and sewage sludge, taken together, is 29·4 per cent., which we regard as somewhat high, considering the nature of one-third of the material. The weight of water evaporated per lb. of material is given as 0·426 lb., or 0·507 lb., from and at 212°. The pressure of air in the ashpits, namely, 2 inches of water, is excessive, as might be expected from the amount burned per cell. The temperature of the combustion chamber is given as 1,562° F., which we may point out is a very different figure from the 2,500° F. of the brochure. The very hot appearance of the combustion chambers seemed to us to be partly due to the red hot particles of dust blown up from the surface of the fire by the excessively strong draught.

Sir Douglas Fox's Report also omits all mention of the fact which we consider of most importance, namely, the cost of labour per ton burnt, in relation to the wages paid, and the number of hours worked by the men. Until these figures are forthcoming, it is impossible to judge between the Leyton plant and destructors of other types.

The City Electric Lighting Service.

The high rates per unit charged by the City of London Electric Lighting Company are naturally, and, we think, very properly, creating a great deal of dissatisfaction among consumers. The City authorities have over and over again expressed regret that the company's powers run over so long a period, and they have brought weight to bear upon the company to secure a reduction in the charges. The company, however, not having inclined its ear unto these words of advice, may have to grapple with the bug-bear of competition, if the propositions now receiving attention by the Court of Common Council come to anything. Whether the Court has or has not the necessary power to compete with the company to which it has granted certain clearly defined concessions, is a matter which will arise in connection with the Court's deliberations directly; but we think the City company would be acting under good advice if it lowered its rates as other companies have done which touch the borders of its own area, without inviting competition in any shape or form. That in the long run a competitive supply would be beneficial to the general City public, and detrimental to the interests of the present company, there is hardly room for doubt. From all accounts, the City Company is doing remarkably well and can easily afford to consider the interests of its consumers in this way. It will perhaps be said that if the rates are reduced there will be a much greater demand for light beyond the company's present or immediately prospective capacity, but that, we venture to think is a matter that can be easily arranged. Of all things the company should avoid a short-sighted policy.

Electric Motors on Hire.

Mr. Alfred H. Gibbings, the Bradford Corporation electrical engineer, who is showing so much enterprise in popularising electricity supply in his city, has sent us a copy of a circular which his Corporation has issued, giving the conditions, charges, and so forth, as to the hire of electric motors. This is mainly for the benefit of small power users in the district to whom a heavy outlay on motors and equipment would be prohibitive. The motors on hire range from ½ to 6 H.P., the rates exclusive of fixing, being from 10s. to 30s. per annum. These low rates bring the advantages of electric power within easy reach of the power consumer, and we should think some good work will thus be done at Bradford and the other towns where the hire of motors is proposed. The gas companies find their best customers among those who consume gas for driving gas engines, and for heating and cooking, and there is every reason to believe, now that the use of small electric motors is becoming more general, that electrical engineers will do much by this means to improve the electricity works' day load.

HIGH ELECTROMOTIVE FORCE.*

By Prof. JOHN TROWBRIDGE.

I have lately perfected a large plant for the study of the discharges of electricity through gases which I believe is more extended, and on a larger scale, than any at present in existence; and I have obtained some results with it, especially in the subject of high electromotive force, which throw light upon many mooted points. The source of electricity which produces the electrical discharges is obtained from 10,000 storage cells. From these cells I obtain very approximately 20,000 volts, and by means of a peculiar

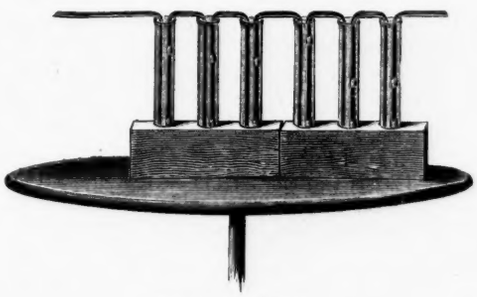


Fig. 1.—The Cells.

apparatus called Planté's rheostatic machine, I am enabled to obtain over 1,000,000 volts—which enables me to experiment with powerful discharges in air, more than 4 feet in length.

By the employment of storage cells in the subject of the discharges of electricity through gases, one can form a fair estimate of the amount of energy that is employed to produce the desired effects—for instance, the X rays; while with the use of electrical machines or induction coils and transformers it is extremely difficult, if not impossible, to form an accurate estimate. Fig. 1 is an illustration of the type of cells of which the battery consists. Each cell is composed of a test tube 5½ inches long and ¾ of an inch internal diameter containing two strips of lead which are separated from each other by rubber bands and are immersed in dilute sulphuric acid. The surfaces of the lead strips are roughened by a mechanical device, and the cells are charged in multiple circuit by means of a dynamo machine. When the cells are properly formed, each one gives two volts and has an internal resistance of one-quarter of an ohm. The problem of insulating these cells was a serious one; but it was practically solved by mounting the cells in sets of threes, in holes bored in a block of wood which had been carefully boiled in paraffin. The mechanician of the laboratory, Mr. George Thompson, devised a simple switchboard which enables me to throw the cells into multiple or into series—to use the entire 10,000, or suitable portions of this number. The battery gives 8 amperes of current with 20,000 volts, and this amount of energy is amply sufficient to kill a man. By accident an operator received the shock from only 1,000 of the cells and was badly shocked and burned. It is prudent therefore in experimenting with this battery to use rubber gloves, even in throwing the switches, and it is recommended to employ only one hand covered with a rubber glove and to keep the other hand in a pocket.

I had at first intended to use this large battery in the study of electrical discharges through Crookes tubes, but I speedily found that X rays could not be excited by a difference of potential represented by 20,000 volts. I found that at least 100,000 volts were necessary to produce them strongly, and I, therefore, resolved to construct a Planté rheostatic machine. This machine is simply an apparatus by means of which Leyden jars are first charged in parallel and are then discharged in series or by cascade. That is, all the inside coatings of the jars are connected to the negative terminal of the 10,000 cells, and all the outside coatings are connected to the positive terminal of the cells. When the cells are charged, the inside of one Leyden jar is connected to the outside of the next, and so on. In this way a very high electromotive force can be obtained. I use 60 Leyden jars in the form of plates of glass 15 × 18 inches coated on both sides with tinfoil. Starting with 20,000 volts, I can exalt this to 1,200,000 volts. The accompanying illustration (fig. 2) shows the Planté machine. The mechanician of the laboratory has introduced a notable improvement in the apparatus of Planté. Instead of a revolving commutator such as was used by the latter, Mr. Thompson employed lever arms, by means of which the jars were first charged in parallel and then discharged in series. It was found that the apparatus designed by Planté could not be used for higher voltages than one or two thousand without serious error and loss. By means of this apparatus I can study electrical discharges at least 4 feet in length—of great body—which are produced by an electromotive force of 1,200,000 volts. This apparatus possesses the great advantage that it enables one to obtain a fairly exact measure of such high voltage. When we reflect that the trolley car employs only 500 volts, and in the system of transmission of power from Niagara Falls it is proposed to use only 10,000 volts, it is evident that the effects produced by voltages of over a million must be of great scientific interest.

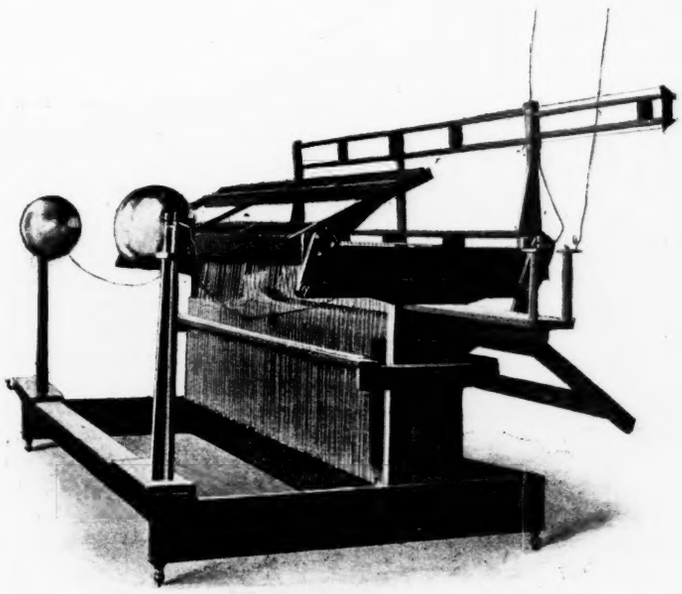


Fig. 2.—Plante Rheostatic Machine.

The study of such high electromotive forces immediately showed that previous estimates of the electromotive force necessary to produce a spark of a certain length were highly erroneous. For instance, Heydeweiler, a German investigator, believes that Prof. Elihu Thomson's statement, that a spark of 5 feet in length which he produced required a voltage of 500,000, is very wide of the mark, and Heydeweiler maintains that 100,000 would be nearer the truth. I find that even Prof. Thomson's estimate must be more than doubled. Experiments with my apparatus show conclusively that the length of the electric spark between points

* *Scientific American.*

separated by more than 1 inch varies directly with the electromotive force. A spark 48 to 50 inches in length requires an electromotive force of 1,200,000 volts, and a discharge of lightning one mile long would therefore require the enormous number of over 100,000,000 volts. In reflecting upon the development of such enormous energy in the air, we can understand why telephone bells ring during a thunderstorm; why subsidiary sparks occur in networks of wires; and why telegraphic messages are interrupted. The world beneath the thunderstorm throbs and pulsates with the oscillatory discharges of lightning.

One of the most interesting results of my study of powerful disruptive discharges is the discovery that such discharges will pass through glass tubes which are exhausted to such a high degree that they are said to contain a vacuum; for the 8-inch spark of a Ruhmkorff coil prefers to jump around the tube to passing through the extremely rarefied space in the interior of the tube. Such tubes, however, are brilliantly lighted by a difference of potential of 1,000,000 volts and readily show the X rays, and exhibit the skeleton of the hand in a fluoroscope. The so-called brush discharge from the positive terminal of the Planté machine extends visibly to a distance of over a foot. If the hand is exposed to this brush, it produces the well known X ray burn, such as various investigators have received in taking photographs of the skeletons of their hands, or in testing the condition of Crookes tubes by exposing their hands before a fluoroscope. The skin of the hand becomes irritable and turns a bright red colour, especially after exposure to cold winds.

This result interested me greatly; for it proved that the so-called X ray burn could be produced by the brush discharge of very high electromotive force. The extent of the influence of this powerful brush discharge is very great. For instance, photographic plates in a plate-holder carefully insulated from the ground and covered with a plate of glass half an inch in thickness show the inductive action of the brush discharge from the positive terminal, which is distant at least a foot. These inductive effects are manifested by star-shaped figures on a photographic plate. They are surrounded by dark clouds. When the burn on the back of one's hand produced by such brush discharges is examined by a microscope, similar centres of disturbance (in this case points of inflammation) are seen. Although the Leyden jars of my machine are carefully insulated on supports of vulcanite which are mounted on dry wood, which in turn is supported on rubber, I can obtain a discharge of more than 2 feet in length when I bring a point connected to the steam pipes to the neighbourhood of one terminal of the machine. The other terminal of the machine is carefully insulated. This experiment shows conclusively that it is of no use to insulate lightning rods. My experiments thus far show that no vacuum which I can produce can resist the discharges which are caused by 1,000,000 volts. It now becomes an interesting question whether there exists mechanical or chemical means by which a so-called vacuum can be produced which will resist such discharges.

SOME NOTES ON SINGLE-PHASE MOTORS.

By A. C. EBORALL.

(*Continued from page* 68.)

The following conclusions may be arrived at, considering the oscillating field of a single-phaser to be of the nature indicated above:—

1. At starting, two equal and opposite torques are exerted on the rotor by two equal fields rotating with equal velocities in opposite directions. Hence there can be no initial torque.

2. As the rotor slowly increases from zero up to a speed near synchronism, the backward rotating field becomes weaker and weaker, and since the backward and forward fields have together to produce a definite back E.M.F. in the stator windings, the forward rotating field must increase in strength, and consequently the resultant torque on the rotor rapidly increase.

3. When the rotor is nearly synchronous, the backward rotating field is reduced to a very small amount. Hence it may be said that on starting, the resultant field is purely oscillating, but when running, the effect of the rotor currents is to produce a nearly pure rotating field. In the rotor bars a complicated current exists, it being the sum of two currents of different frequency, they being of approximately equal strength. The one is due to the very small backward rotating field, and is of high frequency, the other to the main forward rotating field, and is of low frequency. The $C^2 R$ losses in the rotor must, therefore, be nearly double of those in a multiphase rotary field motor. In other words, nearly half the $C^2 R$ losses in the rotor of a single-phaser are due to the backward torque × speed of rotor, this amount of power being simply wasted in heating the rotor conductors. The iron losses will also be greater than in a multiphase motor, owing to the effect of the backward high frequency field.

4. There is a limit of speed before synchronism at which the torque on the rotor again falls to zero. If we consider the rotor running synchronously, the forward field can evidently produce no torque, whereas the backward field gives rise to a negative torque. The zero torque must, therefore, be before synchronism is reached.

5. The effect of leakage or self-induction is entirely detrimental. It has two effects: (1) it diminishes the main torque due to the forward rotating field, and (2) it likewise causes the backward field to be larger in proportion to the forward field. This can be seen from the following:—Let ϕ be the lag of the current behind E.M.F. in one rotor bar. Then the diagram of E.M.F. for this bar is that shown in

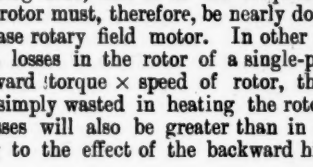


Fig. 5.—Diagram of Rotor E.M.F.

fig. 5, E being the resultant of E_s, the E.M.F. of self-induction, and of E_r, the E.M.F. for the ohmic resistance. From this

$$\sin \phi = \frac{E_s}{E}.$$

Now $E_s = 2 \pi n L C$, where C is the current in the bar, and n the slip. Also the E.M.F. induced in one bar $(E) = \pi n N$ where N is the strength of field. Hence

$$2 \pi n L C = E \sin \phi$$

$$\text{or } C = \frac{\pi n N \sin \phi}{2 \pi n L} = \frac{N \sin \phi}{2 L}.$$

$$\text{But } \sin \phi = \frac{2 \pi n L}{\sqrt{R^2 + 4 \pi^2 n^2 L^2}} \qquad \text{(Fig. 6).}$$

$$\text{Therefore } C = \frac{N \pi n}{\sqrt{R^2 + 4 \pi^2 n^2 L^2}}.$$

From this it is clear that when the self-induction is already the main term in the impedance factor, an increase of L produces a proportionate decrease of C. Where, however, the

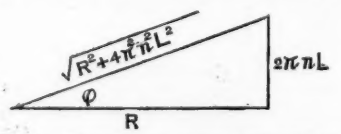


Fig. 6.—Diagram of Rotor Impedances.

self-induction term is but small, the decrease in C is small for a given change in L. The result of this is that the backward field produces a smaller value of backward high frequency rotor current, and consequently where the two currents are equal to one another, the backward field is larger in proportion to the forward field for an increase in L.*

* It is a common error to suppose that self-induction in the motor is absolutely necessary in a successful single-phase motor. It has arisen by not considering that the backward rotating field tends to disappear for the small slips that are met with in practice. The best induction motor of any kind is the one with the least leakage, that is, self-induction.

The construction of single-phase induction motors can now be gone into. Briefly, it may be said that they are constructed in exactly the same way as multiphasers, but with slight modifications, caused by the fact that they are not self-starting, and that the considerations mentioned above have to be borne in mind. The methods used by different designers, in order to get over the starting difficulty, will be described later; generally speaking, these methods take the form of splitting up the single-phase current at starting into two currents differing less than 90° in phase, one of these currents being sent round the working winding of the motor, the other going round a starting winding, the coils of which are wound in between those of the main winding. Hence an irregular two-phase rotating field is produced, which causes the rotor to run up to a speed somewhat short of synchronism, and this being attained, the starting winding is cut out, the working winding put direct on the supply mains, and the load transferred from the loose pulley or other device to the motor pulley. The starting torque depends on the efficiency of the phase-splitter, on the current taken, and on the design of the motor, and is, generally speaking, not very great.

Before considering the construction of these motors in detail, it will be as well to briefly enumerate the general points that must be followed in regard to their electrical and magnetic design.

Firstly, a very essential point is, that both stator and rotor should be quite smooth all round—large polar projections on either must be avoided. If this is not attended to, there is (especially at starting) a tendency for the stator and rotor fields to cog into one another, and as a consequence the effective starting of the motor is rendered impossible.

Secondly, the air-gap must be only just large enough to permit the rotor to run freely without danger of touching. As the no load current and power factor at all loads depend mainly on the size of the air-gap, it is clear that it must be as small as possible. Further, the larger the air-gap, the greater the leakage, and hence the motor will not start so well, and will have a greater slip when running, and diminished power factor.

Thirdly, if the induced rotor currents are not confined to proper paths, so that they may be always properly contributing to the driving forces, there will be false rotor currents which will waste power by heating, and which may even under certain circumstances exert a torque in the opposite direction to that of the forward stator field, and help the backward field.

Lastly, the arrangement of the stator winding and iron parts must be such that the leakage field is a minimum, otherwise there may be eddy currents in the motor frame, and even in the stator conductors themselves, causing loss of energy; furthermore, if there is much leakage from any cause, the bad effects before mentioned will be present to a greater or less extent.

The methods adopted in practice to satisfy these conditions will now be considered.

(*To be continued.*)

SMALL LIGHTING PLANTS.

An article headed "Small Lighting Plants," by Mr. Fred. C. Reeve, in the *Electrical World*, deals with three important questions, namely:—

1. Can the lighting companies materially lower the present rates if brought into competition with the "isolated plant?"

2. Are very small plants, varying in size from 25 to 300 lights, practical?

3. Under what conditions can they be made a success financially?

The basis of his calculations are taken on the average prices charged in America for the four most popular illuminants, and are as follows:—

(*a*) Ordinary gas light, costing ·875 cents per 16-C.P. hour.

(*b*) Incandescent gas light, costing ·65 cents per 16-C.P. hour.

(*c*) Incandescent electric light, costing ·90 cents per 16-C.P. hour.

(*d*) Enclosed arc light, costing 6 cents per 1,500-C.P. hour.

In cases where the demand for current is spread over a large number of hours, such as large factories and workshops, where the items of interest and depreciation would therefore be spread over a large number of units, it is shown by a table of costs of operating plants that electricity can be generated privately at a less cost than the average price generally charged.

Persons will gladly pay for the convenience afforded by the central station supply in their houses, but in the store, factory, or workshop where economy has to be practised, the matter is treated differently, and these considerations account for the large number of isolated plants in America, and no doubt also at home in England.

The rapid spread of electricity within the last few years, and the publicity given to the details of cost in generation, management, &c., have set probable large consumers thinking, and their education has in many cases led to the loss of good customers, for knowing that dynamos can be relied upon to work practically without attention, and with little fear of breakdown, the additional responsibility of an extra machine in a large works spreads itself over the whole just as the items of interest and depreciation spread themselves over a larger number of units generated, and logically speaking, the larger the works the less the additional responsibility is felt.

The isolated plant of to-day is quite different from that of a few years ago. Before the introduction of central station supply, we were indebted for a good deal of our early knowledge to isolated plants. Just as doctors must learn their profession and patients must be practised upon, so had the electrical engineer to learn his profession, and the isolated plant owner was often the patient sufferer, the martyr to science. The disappointments and failures of the days referred to were often due to the scant knowledge then possessed by the engineer, and these failures have led to such improvements, that it is difficult to see where further improvements can take place.

The lessons taught were not long in being acted upon, and central stations began to make their appearance at different places some ten years ago, and have gone on increasing year by year, each succeeding year bringing more and more. The primary lesson learned was, that electricity generated in sufficiently large quantities could be generated cheaply and made a commercial commodity. The owners of large works, shops, stores, &c., have also learned this, and following in the footsteps of their former tormentors, are putting down their own plants, some of which rival in capacity many central stations.

Although isolated plants are not adapted for domestic light, except for country residences where current cannot otherwise be obtained, it is obvious from the silent evidence of the increase of isolated plant in business premises, that when a sufficient number of lamps are installed, and when they burn for a considerable time each day, the current can be very cheaply generated.

It points to the fact that sooner or later electricity will have to be supplied at a very much cheaper rate than at present, or the steady commercial lighting will be operated by the isolated plant, and the only customers retained will be the domestic and intermittent commercial work.

The systems of charging for current must be considerably modified to enable the business man to cheaply light his factory if current is to be bought, and he must pay a higher rate for current used for domestic purposes.

COMPARATIVE COST OF STEAM AND ELECTRIC POWER.

I.

Electrical power transmission being as yet in the aggressive stage of development, and called upon to show

cause why it should be adopted, it is natural, that from time to time, should appear comparisons of costs with steam power. One of these appear in the *Electrical Engineer* (New York), by Mr. Irving A. Taylor. So far as regards steam power costs in America and here, the probability is that comparisons made in one country will stand good for the other. Mr. Taylor attributes the small attention given to power economy to the idea that power is only thought to be a small item in total costs of manufacturing, and also to the fact that power distributing is a special subject not understood much by manufacturers. There is nothing easier than power distribution, and anyone can get out a plan for doing it, but it is all done by guess work, and the result is often an expensive tangle of belts entirely preventing the use of overhead travellers, as well as being enormous power absorbers. It is not simply the sheer cost of power that is to be counted, often enough it is the incidentals, and this is specially the case where small steam engines are employed.

So much depends on arrangement, and the author cites the case of a shop remodelled to give a four-fold output, which produced as much as seventeen-fold with ease. In this case, arrangement combined with electrical transmission and compressed air for certain duties has been the cause of improvement. Now, air power is costly, but it is extremely useful in the right place, and though giving only 15 per cent. efficiency, being used cold, it saves in labour and increases output. The question is asked, what is the best way to lay out a power plant? The answer is, that where large amounts of machinery are to be driven, certain power centres may be found to which, while power is being used, power may be supplied at a fairly constant rate, and with a high load factor. Such centres may supply simply one machine, or a group of machines, a whole floor or section of a shop, but no large power must be sent far along a line of shafting or a number of belts. There is a tendency to medium sizes of motors, 3 to 15 H.P. They ought to be fairly well loaded, and their efficiency must not be obscured by complicated belt systems. When the load on a machine or a group is nearly constant, the group or unit is to be as directly connected as possible to the motor. Machines absorbing a small but variable power require grouping in considerable numbers on one motor, so as to obtain an even average. Where possible, variable and steady demands should be separated. Thus we want to run a 5-horse blower all day, and a couple of machines consuming from 0 to 10 H.P., and averaging about 2 H.P. The costly part of this load will be the blower. If we use a 15-H.P. motor, the costly load will be run usually on a half loaded motor, through belts and shafts, and will cost double what it would if it were run with a 5-H.P. motor on the blower shaft direct. The group would thus require two motors. But if the maximum load of 10 H.P. on the other machines had never fallen below an average of 7 to 8 H.P., possibly one motor would best have served the group. The author is very severe on a crossed belt. With its two rubbing sides exerting a backward pull of 7½ lbs. at 2,200 feet per minute, the cost of this 1 H.P. of friction will be £20 to £60 a year, a rather expensive price for a crossed belt!! There is no excuse for a crossed main belt, and only necessity should permit any crossed belt to be run. The author saved 50 per cent. of power by uncrossing a main belt. It took half an hour to arrange this. Belts are often the best transmitters for short spans. For spans of 100 feet, a wire rope will be satisfactory where loads do not vary suddenly; but in America wire rope transmission has not been a success—it demands too many conditions; is too curbing. The same applies to compressed air. It is used in Paris, with reheating to 300° or 400°—an essential to economy for large air power. But who wants a fire to make up? People who buy power want it ready cooked, not raw, like compressed air. Electricity has the maximum of convenience and the minimum of waste over any distance, and is bound to win on the score of convenience, if for no other reason. The trouble with electricity is, so far, with those who sell rather than with those who buy. There is so much hesitation in replying to an intended user's questions. It looks as though there were doubts as to success, and so on, and this is not encouraging to users. In Mr. Taylor's further discussion of the question he gives figures to show the advantages of electricity which we propose to reproduce.

(To be continued.)

AN ELECTRICAL HYPOTHESIS FOR THE SOLAR AND PLANETARY SYSTEMS, AND SOME OF THEIR ASSOCIATED PHENOMENA.

By DELTA.

(Continued from page 74.)

II.

Since the first article was published in the Electrical Review, the solar eclipse of 1898 has been carefully observed, and under favourable conditions, and according to cable information the general shape of the solar corona was generally like that seen in the eclipses of 1867, 1888 and 1896, so that it may be assumed that there is little variation, if any, in

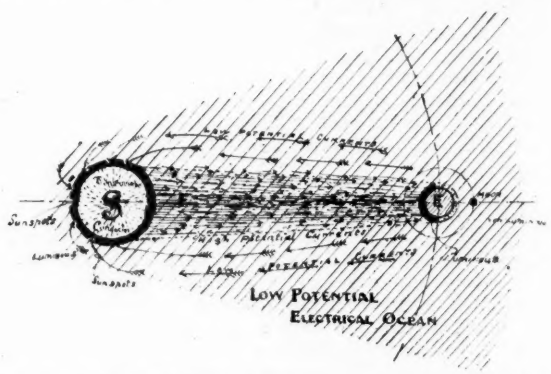


Fig. 1.—Graphic Diagram Showing the Cycle of the Conservation of Energy Forming the Basis of the Solar Electrical Hypothesis.

the sun's great electrical potential. The varying luminous intensity of the solar triple and concentric envelopes is merely due to the varying degrees of resistance offered to the outward passage of the high intensity electrical energy. The photosphere is probably composed of gas of such high tenuity, as to offer no resistance whatsoever.

The diagram, fig. 1, is intended to graphically explain the author's electrical hypothesis. Fig. 2 gives a rough idea of

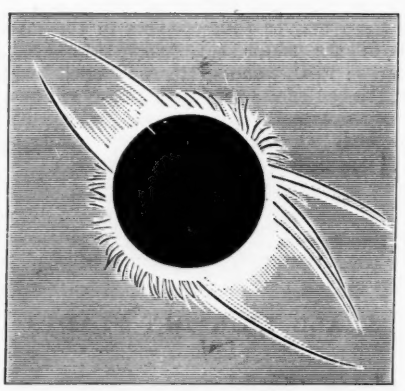


Fig. 2.—Total Solar Eclipse, July 29th, 1878, showing Electrical Streamers.

the appearance of the solar corona. Before proceeding to extend the application of the electrical hypothesis to explain stellar and other phenomena, it may now be an advantage to examine its value, as an explanation of common atmospheric effects.

Cloud Effects.

Aqueous vapour, in the form of clouds (by the well-known attractive influence that water has for electricity), may be said to constitute suspended electrical conductors, that become electrically charged to saturation.* The discharge of these

* An electrically charged cloud induces electricity of an opposite kind to its own.

cloud forms of electrical conductors may be induced by the earth itself, or by a highly electrified wind current, and also by the influence of solar electrical currents that produce the ultra-violet rays.

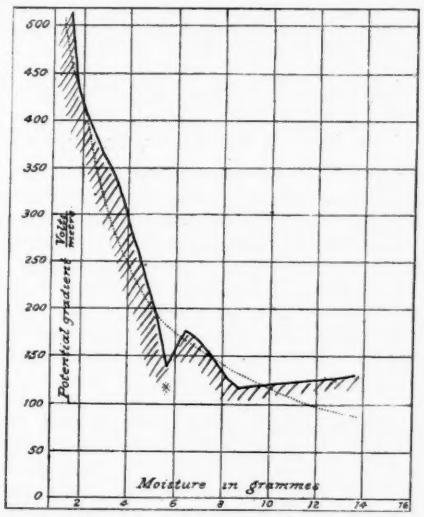
The discharge of the clouds will be induced by contact with any strongly electrical energy absorbing surface.

The strange phenomenon of the water spout, the aqueous column uniting the clouds and the sea, is an example of the powerful and irresistible attractive influence of masses of water, that culminates in the rapid discharge of the clouds' electrical accumulation.*

There are always stronger indications of electrical energy on hills than in valleys.

The Influence of Aqueous Vapour on the Electrical Condition of the Atmosphere.

The influence of the proportion of aqueous vapour in the atmosphere in its effect on the degree of resistance offered to the flow of electric energy is well known.



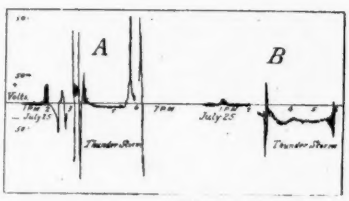
——— Actual curve. ..... Estimated curve.

Taken from Elster & Geitel, *Fitz K. Akad der Wiss, Wien.*

Fig. 3.

The discharge of a rain cloud rapidly clears the atmosphere from an excess of electrical energy. The influence of a highly aqueous vapour condition in altering the electrical potential of the atmosphere is shown by diagram, fig. 3. This diagram 3 is constructed from tabulated results of observations made at Hofner Sonnblick at an elevation of 10,168 feet above sea level, and also at the low level station of Kohn Saiguon. It will be noticed, on referring to the graphic diagram, fig. 3, that the curve of electrical potential runs in a line inversely to that of aqueous vapour pressure.

A casual test made at Massachusetts, by means of a kite connected by wire with a quadrant electrometer, was raised and maintained at some elevation above the summit of Blue Hill, at such a position as to intercept an approaching thunderstorm.



A 194 m. above sea level, and B 74 m. above sea level.

Electrical Potential of the Air Photographically Registered at Two Stations.

Fig. 4.

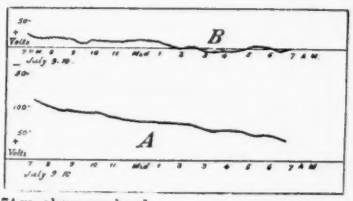


Fig. 5.

At 7.40 a.m. this thunderstorm, which for some 20 minutes had been approaching from the west, was near enough to cause an incessant stream-like flow of sparks from the kite-string.

If a ground wire was held within a fraction of an inch from the kite string, a spark discharge followed.

After the rainfall, no sparks or any electrical indication could be drawn from the kite-wire.

Cloud disruptive discharges occur when the electrical tension in the atmosphere between the clouds and the surface of the earth exceeds a certain critical value not yet determined.

It would appear that as the voltage increases with the height of elevation from the earth's surface that clouds at various heights will have distinctive electrical characteristics; therefore we should expect that cloudland will be essentially of a stratified character.*

The variation of electrical potential from the inception to the termination of a thunder storm is a striking proof of the masterly factor that electrical energy occupies in terrestrial processes, and is itself evidence of no inconsiderable value in supporting the author's new hypothesis.

Thunder, Hail, and Snow Storms.

Diagram fig. 4 shows the striking variations of electrical potential during thunder storms, at both an upper and a lower placed station.

The diagram 5 shows the normal variation of potential characteristic for fine weather. It will be observed that the electrical intensity shows a decided drop from morning until evening.

The violent changes of electrical potential of our atmosphere are not only associated with thunder storms. During hail and snow storms we have acute changes of potential. The diagram fig. 6, for which we are indebted to Mr. McAdie, is a very striking exhibition of the great potential fluctuations that exist during a snow storm.

The observations at Sonnblick indicated that cloudless days were associated with an apparently constant and equable fall of potential, maximum (July) between 7 and 9 a.m., followed by a regular reduction of potential to a minimum at the evening.

Observations in a cloud that discharged a small quantity of rain showed the electrical potential to gradually drop to zero value, where it remained for some time.

It has been noticed, as a rule, that in storm clouds the atmospheric electricity usually changes its sign after a lightning discharge, the same change occurs with storms occurring on a plain.

The Formation of Hail and Snow Particles.

It is well known that the flow of static electricity between pointed terminals, and through an atmosphere charged with particles of suspended matter, in a condition free from moisture, has a very curious effect. Some of the particles become immediately electrolysed and polarised, and they form nuclei centres of magnetic attraction and aggregation, the small particles rapidly coalesce to form larger ones.

One might attribute the formation of hail, and, in a manner, perhaps, of snow or other forms of frozen vapour, to this action of electrical coalescence.

In hail storms the highly electrical condition of the atmosphere is particularly noticeable. The electrical intensity potential was noticed by the observers at Sonnblick to increase and decrease with the fall of hail.

Diagram, fig. 6, shows the violent electric changes that accompany a snow storm.

Probably the electrical coalescence forming hail takes place at the altitude coincident with that of the Cirrus cloud, at some 5½ miles distance from the earth's surface.

* Peletier states that water spouts are accompanied with striking electrical manifestations.

* Hildelrandsson showed that the upper currents move along somewhat parallel to the lower currents, up to a certain height.

According to the law enumerated by Leys:—

Upper clouds have a distinct centrifugal tendency over areas of low pressure, and a centripetal one over those of high.

The Variation of Electrical Potential in Winter and Summer.

The average atmospheric electrical potential is higher in winter than it is in summer—there is less moisture as such in the air, and the absorption by the earth will, it is thought, be slower in winter than in summer.

The moisture in summer months constitutes an excellent conductor for the flow of the electricity to the earth's surface.

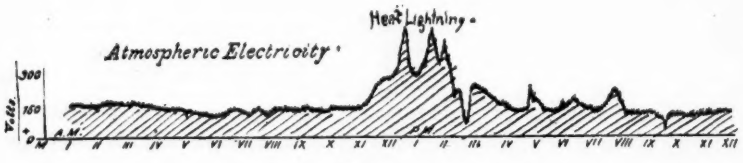


Fig. 6.

Dryness of air, on the other hand, offers a greater resistance to the flow of electrical energy, and hence the tendency to the creation of a highly electrified atmosphere, a prelude to the atmospheric electrical phenomena we know as the magnetic storms.

The Increase of the Electrical Intensity Potential with Increase of Altitude.

If the author's electrical theory is correct, it would mean that the solar electrical intensity potential would be highest at its entrance into the earth's atmospheric envelope, and that by the dispersion of part of its energy in generating heat and light it would become less and less as it approached the earth's surface; or, inversely expressed, *the electrical potential would increase in proportion to the distance from the earth.*

That this is so is shown by diagram fig. 7. The curve shows the rise of electrical potential with height above the surface of the earth.

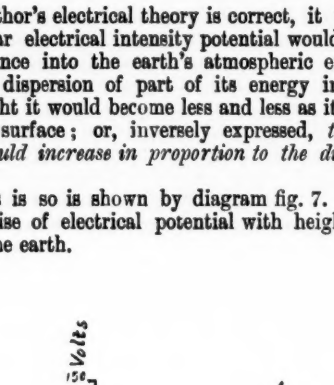


Fig. 7.

Exner's experiments with the water droppers, and made at comparative low levels, showed that whilst the voltage at a height of 17 metres was 100, it increased at a height of 40 metres to 280. He deduces from this that there is a rise of 6—8 volts per metre of elevation.

The Limit of Extent of the Sun's Atmospheric Envelope.

Before enlarging further on this important fact of rise of potential, which in itself clearly shows that the earth cannot be considered to be the primary source of electrical energy, because if it did the electrical intensity would be greatest at the surface, let us attempt to define the limit of the earth's atmospheric envelope. By calculating on the basis of the pressure exerted by the atmosphere upon the earth, equivalent to 30 inches of mercury, the atmosphere only extends some five miles; but this calculation is obviously erroneous, from its neglect to allow for the highly tenuous character of the fringe of the earth's atmosphere.

Meteors having been noticed to evolve gas at a distance of 120 miles from the earth, it is clear that even at this distance extreme atmospheric attenuity cannot have been reached.

That the resistance to the flow of the high tension solar electric currents does not commence to be of sufficient intensity as to produce any luminous or day-light effect until it reaches a distance of 45 miles from the earth is shown y the duration of twilight.*

The all of the electrical potential will vary with the density of the atmosphere, so that Exner's factor of 8 volts increase per metre of distance can only be taken as in any way reliable within a short distance from the earth.

If we take half this factor, or 8, to represent the rise of potential per metre of elevation, we should then have a voltage value, at only five miles distance from the earth, of

$$\frac{\dagger 1{,}609 \times 5 \times 8}{2} = \text{to } 32{,}180 \text{ volts.}$$

The Zone of Electrical Potential.

If the electrical energy flowing from the sun at high tension and frequency enters the atmosphere, and is absorbed by the atmosphere and the earth, the latter must constitute the zero of potential. The discharge of low intensity electrical energy from the earth into the low potential electrical ocean will not generally illuminate the atmosphere, although there are evidences of such discharges from prominences that have produced luminous effects. Such an example is suggested in the phenomenon of Saint Elmo's fire.‡

Wind and other Currents Electrically Initiated.

Wind currents—particularly those carrying with them suspended particles of hail or snow, are highly electrical, and there is little doubt but that high potential electrical discharges play as important a *rôle* in the production of wind currents as does the more generally accepted explanation of the cause, the effect of heat.

The discharge of a high tension current from one to another, or from a point on to the atmosphere, *sets up a decided flow of air.*

If it is accepted that high tension solar currents flow at their maximum at the equator, then this line will coincide with the initiation of powerful and continuous trade winds. Any chart showing the direction of the prevailing winds will demonstrate that the trade winds are initiated at the equatorial line.

That the discharge of electrical energy into the ocean, will indirectly influence the ocean currents, is probable. The maximum oceanic absorption of electrical solar energy at the equator, may constitute this locality as a locale of initial motion of oceanic currents.§

The wind currents flow from the land to the sea at night, and from the sea to the land at the day time.

The general theory for this change of direction being the alternate influence of the heat of the earth and that of the sea.

The inflow to the earth of the high tension electrical currents in the day, and the outflow of this energy at night, may by repulsive influence on the air have some part in the play of the natural forces, producing the wind currents.

The Relation of Barometric Influence on the Electrical Intensity Potential.

The degree of atmospheric resistance to the flow of elec-

* Slightly luminous clouds have occasionally been seen at night that were calculated to be at a distance of more than 45 miles; it is suggested that their interception of strong solar light intensity electrical currents has produced the strangely luminous effects, silver clouds in an atmosphere of the darkest night.

† Mils reduced to metres.

‡ Buchan records 15 cases of Saint Elmo's fire emitted at night time from the summit of Ben Nevis, between the years 1883 and 1888.

§ The oceanic currents appear to flow from the north, from the south poles, towards the equator, establishing cycles of direction, north and south of the equator.

trical energy being a function of the atmospheric density, it will, therefore, be obvious that a change in the barometric pressure will set up varying resistances, and varying electrical repulsive effects that will cause wind currents. Another cause would be the generation of heat as a *pari passu* effect of the increased resistance to electrical flow, and this heat would tend to expand the air, a common means of producing wind circulation.

It has long been known that some connection exists between the height of the barometric column and the direction of wind currents.

For instance, 10 years' consecutive observations have shown that the least mean barometric height corresponds to the great south winds, and the greatest mean height corresponds to the great north winds. The change of barometer will necessarily mean a change of atmospheric electrical potential, and either an increased or decreased, and corresponding degree of repulsive action, on air.

It has been explained that the dispersion of electric energy of high intensity from a pointed conductor, sets up wind currents by electrical repulsion, it is not, therefore, an improbable suggestion to put this cause as the master one amongst other, and purely physical causes, that set up the flow of air currents. It has been suggested that highly-electrified wind currents may, independently of temperature influence the discharge of highly-aqueous clouds of accumulated electric energy.

Temperature of the Upper Atmospheric Strata.

Let us assume that the temperature of the atmosphere depends upon the resistance offered to, and on the proportion to the electrical energy passing through the atmosphere. The resistance is a function of the atmospheric density, and as the density of the atmosphere decreases, as its distance from the surface of the earth increases, this would necessarily mean that in proportion as the distance from the earth increased, the temperature would decrease; in other words, the temperature would in some measure be inversely proportionate to the distance from the earth's surface.

Aerostatic observers have discovered at the equator, that for each elevation of 187 metres there is a drop in temperature equal to 1° C.

Taking the temperature at the equator to equal 25° C., then at a distance of five miles the temperature will equal

$$25 - \left(\frac{5 \times 1{,}609}{187}\right) = 18° \text{ below zero.}$$

Now, from evidence that has already been adduced relating to the Cirrus clouds and to cometary bodies, it is quite certain that outside the five miles of atmospheric environment the temperature is very many degrees below freezing point. We have nearer evidence in the fact of the mountains being capped with everlasting snow.

If the ordinary theory were correct, these prominences would be the first to meet the assumed rays of light and heat from the sun, and the summit of the mountain would be hotter than the valleys around its base. A somewhat similar objection applies to the ordinary theory of transmission of light from the sun.*

The Zodiacal Light.

The electrical hypothesis provides one speculative explanation for this phenomenon. It is suggested that the apex of the zodiacal light is the outer fringe of the earth's atmosphere, having such a density that by resistance to the flow of electric energy, it is capable of being made luminous. As the atmosphere projects miles beyond the earth's surface when an observer is on the surface of the earth removed some limited distance from the area upon which solar electric energy is acting, he should be able to see the reflection of the earth's luminous atmosphere in the form, say, of part of the frustrum of a sphere.*

The Supreme Importance of the Subject of the Electrical Condition of the Atmosphere—a Suggestion.

Before proceeding to the application, necessarily highly speculative, of the electrical hypothesis to the planetary, stellar, and their associated phenomena, the author wishes to emphasise the urgent, if not supreme importance, of the subject of the electrical condition of the atmosphere. This subject transcends all others, not only in its relation to vegetable organic life, but also to that of human life. The stimulating effect of electrical energy on vegetable life is well known, and this subject alone deserves national recognition.

The author is satisfied that it will be found correct to say that nearly all diseases, and more especially those having a nervous origin,† are in some measure connected with specific electrical atmospheric conditions, and there is little doubt but that the conditions that best secure immunity from any epidemic or other disease, will be found to be coincident with *pari passu* electrical characteristics, but especially with the atmospheric electrical potential.

We must have day by day records of the variation of electrical potential and other electrical changes, along with the barometrical indications from all our meteorological stations. The meteorological stations should be increased at least to double the present number, and be supported by the State.

With this electrical data, we should be able, if not to prevent, at least to counteract the influence of an electrical potential found to be dangerous to satisfactory health conditions of either animal or vegetable existence.

A human sufferer could be removed to positions when the electrical conditions were found to be hygienically beneficial.

By means of the proposed stations the prevalence of electrical changes, magnetic storms, and other electrical phenomena, would soon supply abundance of data of incalculable value to the well-being of the people.

The correlation of the electrical characteristics with hygienic, astronomical, and atmospheric, and other effects could be more exactly determined, and there would then be no necessity to incur blame and displeasure in attempting to formulate speculative theories, however well justified they may be, by correlative and coincident evidence.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the last meeting of the Institution of Electrical Engineers, held on Thursday, January 27th, at the Institution of Civil Engineers, Major-General Webber read a paper entitled "Notes on the Electro-Chemical Treatment of Ores Containing the Precious Metals." General Webber prefaced the presentation of the actual paper by explaining that the subject was such a broad one, while his remarks were confined to one or two particular departments thereof, he did not feel justified in describing what he had to say as more than "Notes." The paper, like many others laid before the Institution, is evidently intended to awaken and stimulate thought on particular matters, and is timely as following up the subject matter of the presidential address so recently delivered. We allude to it at length in another column.

On conclusion of the paper, the President called upon M.

* To demonstrate this difficulty one has only to formulate the following argument:—

Axiom.—The intensity of light is inversely as the square of the distance from its source.

Hypothesis.—If the ordinary theory were correct, the maximum intensity of sunlight (which is considered to be four times that of the electric light) would and sequentially be equal at the sun to the determinate quantity, x, given by the equation

$$z \times (93{,}000{,}000)^2 = x,$$

where z equals the photometric and thermal value of the sunlight at the surface of the earth, and this z quantity may be calculated thus: the temperature of an ordinary arc and actinic light has been variously estimated, but if we take it to equal 2,500° C., then the intensity of the light at the sun will be equivalent to a temperature that is beyond the regions of even the wildest fancy, and this figure alone appears to be fatal to existing theories.

* Prof. Bigelow considers the zodiacal light merely as an amassment (in the plane of the sun's equator, and at a place of zero potential) of particles electrically propelled from the sun.

† Every living thing on earth may be rightly considered to be a producer of electrical energy, and each one is more or less highly, if unconsciously, susceptible to the varying electrical conditions of the atmosphere. We have an example of this in the prevalence of neuralgic and similar attacks at certain phases, as yet undefined, of the electrical and atmospheric potential.

Pelatan to open the discussion. This gentleman modestly disclaimed a thorough acquaintance with the English tongue, and stated that he thought the paper gave full particulars of the process in which he was interested, but expressed his willingness to give any further details that might be desired. Later in the evening M. Pelatan had the opportunity of dealing with some of the criticisms, and ably put forward his views in excellent and clear English.

To Dr. Teed fell the part of leader of the attack, and this position he filled with evident relish, and at considerable length. He opened by stating that the paper wanted pulling apart and reconstructing, particularly by setting those processes which are intended for the electrical removal of metals from solvents on one side, and on the other, such as are intended for the making of solvents by electrical treatment. Thus the Siemens & Halske process was one for removing gold from a solvent, while the Pelatan-Clerici had in view the making of a solvent, and dissolving out the gold by this solvent. Molloy, whose name was mentioned in the paper, only attempted to remove gold from a solution, by making a sodium amalgam.

Coming to the Pelatan-Clerici process, Dr. Teed expressed his wish to have explained the meaning of the statement in the paper that certain mixing was done in the treatment tank itself, part of the gold being alleged to be extracted in the vat, and part after the liquor had left the vat. He considered the chemistry of the process involved, while nothing seemed to show that one sort of ore was differentiated from another. Ferritic ore, for example, could not be treated electrolytically, but must be dead roasted first. Then as to cost, the question was, what did it cost to agitate per ton of ore, and how much did the electric current cost per ton? Following this, Dr. Teed cited several processes in which potassium cyanide alone was used to extract the gold from an auriferous ore, the quantity of cyanide employed per ton being less than that mentioned as necessary in the electrolytic process. Warming up to the attack, the Doctor continued that the facts put forward honestly in the paper formed a condemnation of Petalan-Clerici process, and asked, "Could any opponent say anything more virulent? Ridiculous is not a strong enough word for it."

After a few remarks from another speaker—Mr. Herroun, of King's College, on the chemistry of the last-mentioned process—Mr. Sulman, whose name, jointly with that of Dr. Teed, was referred to in the paper in connection with the Sulman-Teed process, rose to wish every success to the process so strongly condemned by his partner, to name certain processes of historical interest which were omitted in the first part of the paper, and finally to pile up a list of theoretical and practical objections to the Pelatan process, particularly questioning the advantages of having to agitate, the improvement in yield due to this process, and the cost of the necessary plant, energy, and solvent. He concluded by stating that it might be that unwittingly an injustice might have been done to the process, but economy is the touchstone of any method of extraction, and by cyanide alone 90 per cent. of the gold can be got from an ore.

Several speakers dealt generally with the subject of the paper; one expressed himself as looking with extreme sympathy upon the attempts to utilise the old Hungarian Mill with the use of electricity to keep the mercury alive.

M. Pelatan then rose to give explanations on some of the detail points referred to by different speakers. He stated that in the mixing vat a quantity of pulp collected, and that the gold was actually got partly in one way and partly in another; the first treatment, lasting two hours, being performed without electrical assistance, a certain quantity of gold was taken up in the mercury.

With regard to the former used in agitation, it was necessary to compare things and processes that were comparable, and the particular use made of agitation in his case, was very different to what was attempted by other inventors. Thus some processes require the cyanide, vat and stuff to be agitated, but he only desired to agitate the pulp undergoing treatment in the vat, and he had found by experience that only half a horse-power was required to stir up five tons of crushed ore.

The consumption of cyanide depended upon the condition of the ore treated, the tailings on the Rand were in a washed condition, the slimes having been taken away already. In any case the figure of 2 lbs. of cyanide per ton, was a very great maximum, and in every-day practice he had not found it necessary to use such a large quantity.

At this point the discussion was adjourned, and the meeting broke up, a general topic of conversation, as the members trooped from the hall, being the extraction of gold, not necessarily, however, from ores, or by electro-chemical means.

LEGAL.

Improved Electric Glow Lamp Company *v.* Edison & Swan United Electric Light Company, Limited.

This case, which was briefly noticed on page 122 of last week's Electrical Review, was heard before Mr. Justice Mathew, in the Queen's Bench Division, on Thursday 27th ult.

Counsel for the plaintiffs, Mr. Bousfield, Q.C., M.P., Mr. Wallace, Q.C., and Mr. A. J. Walter. For the defendants, Mr. Fletcher Moulton, Q.C., and Mr. J. C. Graham.

Mr. Bousfield, in opening the case, said the plaintiffs were a company incorporated in March, 1896, their name indicating the nature of the business they were proposing to undertake. The defendants were an old-established and well-known company, having a very high reputation in the electric lighting world, the demand for lamps of their make being very large. That being the state of the case, the plaintiffs being a new company bringing out a new lamp, negotiated with the defendants for its manufacture. The lamp differed from the ordinary type. The ordinary lamp was pear-shaped. The plaintiffs' lamp, on the contrary, endeavoured to get the lower surface as flat as possible, and the upper surface of such a curve that the two together, when part of the glass was silvered, gave the most favourable results as regarded illumination. It was cheaper, gave greater lighting power, and consumed less than the ordinary lamp. The negotiations took place between Mr. Fanta, the managing director of the plaintiff company, and Mr. Jacob, who at that time was the general manager of the defendant company. The basis of all the discussions was, that the defendants should work with the plaintiffs in bringing out the new lamp. The motion was, that the defendants should be the sole manufacturers of the lamp, should supply it to the plaintiffs, and share with the plaintiffs in the profits of the trade resulting from the introduction of the article, which both should push. On the basis of that arrangement, an order was given for the manufacture of 100,000 of these lamps, which was in writing, and was the only contract upon which they were suing in this action. The defendants began to manufacture under this contract, and to make deliveries under it. The date of the contract was the letters of November 3rd and 9th, 1896, and the rest of the arrangement was reduced to writing on November 26th. They could never get the rest of the arrangement confirmed in writing, and it never was. In the meantime, while this arrangement was going on, unknown to plaintiffs, the defendants experimented and introduced a lamp which was nothing more nor less than an absolute copy of the plaintiffs' lamp, the only difference being that instead of the reflecting part of the top being silvered, it was made of opal glass. The defendants had taken out a patent for their lamp on January 10th, 1897, but the plaintiffs did not know this until a later stage. They knew, however, from the delays that were taking place that there must be something wrong. On March 5th, 1897, they learned what was the matter when an advertisement appeared in the Electrical Review announcing that the defendants had introduced a new orb into the incandescent lamp world. This lamp was called "The Queen of Lamps." It was described as giving a perfect diffusion of light, and as being unquestionably the lamp of the Diamond Jubilee. An action was brought by the plaintiffs against the defendants for infringement, but with that his Lordship was not now concerned. The defendants thus avowedly entered into competition and rivalry with the plaintiffs with a lamp which, as far as bulb was concerned, and everything else except the substitution of opal for silver, was identical with plaintiffs. During the months of April and May, 1897, the total deliveries were under 4,000; that was to say, that during the eight weeks preceding the issue of the writ on May 20th, there was only two weeks' supply delivered. Up to the present time there was still a small number of lamps unfinished under this order. The defendants had alleged that the delays were due to the plaintiffs not giving them instructions as to certain details, such as "capping," but that was not really the case. The capping was a simple question, and could be done at the rate of 800 a day. As a matter of fact the plaintiffs had agreed to pay for the lamps as completed lamps at the stage before they were capped, the defendants to keep a quantity in stock and then "cap" them. It was quite impossible in this trade for the plaintiffs to put the lamps upon the market until they had accumulated a stock, unless they had somebody behind them like the defendants, who had a large output of such articles. If the plaintiffs' arrangement had been carried out when they had got 10,000 or 20,000 accumulated, they could have put the lamps on the market, but without someone behind them like the defendants, who could manufacture at a rapid rate, it would had been necessary for them to have accumulated 30,000 or 40,000 lamps. There were three different voltages and four different candle-powers so that altogether there were to be twelve varieties of lamps from the one shape, namely, the conical. The first specification was for 66,000 lamps, of which 46,000 were to be of the conical and 20,000 of the round type. The plaintiffs had a large Continental trade where foreign lamps were considered as good as English made, but these particular lamps were required for the

English market, and it was essential that they should be of English manufacture. In consequence of the failure of the defendants to fulfil their part of the contract they had to carry out certain English contracts by supplying foreign-made lamps, whilst other orders they had to reject.

Mr. Justice Mathew suggested that the question of liability should first be considered.

Mr. Moulton said it would perhaps assist the Court if he stated the defendants' view of the case. It was that no contract had ever been entered into. Unquestionably an arrangement was made that the defendants should supply the plaintiffs with lamps to the extent of 2,000 a week. The letter of November 9th left matters still to be arranged verbally, but the next letter showed it was very much a matter of doubt whether any strict contract was ever entered into. There was a good deal of trouble in making the lamps originally, and hence there was some delay; but the defendants were always supplying the lamps. The plaintiffs, he contended, did not suffer any business damage whatever, and as to the allegation that the defendants put a rival lamp into competition with that of the plaintiffs, there was no foundation for such a statement. The defendants did not receive the specification from the plaintiffs when they ought to have done, and again they were entitled to a reasonable delay for capping. There never was a time when the plaintiffs could not have as many completed lamps as they required.

Evidence was then called for the plaintiffs.

Mr. Fanta, managing director of the plaintiff company, examined by Mr. Bousfield, said the sole object for which the company was formed was to manufacture and sell this improved glow lamp. In 1896 he had several interviews with Mr. Jacob on behalf of the defendant company, and negotiations as to the manufacture by the Edison-Swan for the plaintiff company. Mr. Jacob said he knew if they were to manufacture the lamps the two companies would have to work hand in hand. Altogether there were three or four interviews before the letters of November 3rd and 9th. Ultimately, pending the acceptance of terms, an order was given and accepted for 100,000 lamps to be manufactured by the defendant company. Witness gave evidence as to the nature of the contract, which was disclosed in the letters. He said that the total number of lamps, both of round and conical shape, invoiced by the defendants in accordance with the contract up to April 7th, was 17,279. Of these, 8,904 were conical, and 8,375 round. Between March 31st, the date of the last delivery, and May 20th, the date of the issue of the writ, the total number of lamps delivered was 4,600. Assuming that at that date there should have been delivered 30,000 conical lamps in accordance with the contract, only 8,904 had actually been delivered. Of the 8 or 10 candle-power lamps, 18,000 should have been delivered, but up to the date of the issue of the writ only 597 had been supplied. This failure of delivery had prevented witness's company from placing the lamp on the market from the very beginning. They wanted to put on the market an English-made lamp, which was suitable for the English market, being much more durable than the foreign-made article. The price they were to be paid for a certain lamp to the defendants' company was 1s. 1d. per lamp, but they could get a similar article on the Continent for 6d. It was not so good as the English make, nor was it so durable. As the defendant company did not supply the lamps according to the contract, the plaintiffs could not put the articles on the market because they had no stock. That meant if they had secured orders their small stock would have soon been exhausted, and they could not have continued the supply, which would have been detrimental to the company. Had the defendant company conducted the supply according to their contract the plaintiffs could have put them on the market as they had originally contemplated.

Cross-examined by Mr. Graham: The policy of his board was to have English-made lamps, which were to be manufactured by Edison and Swan, who had offered to do the work. The plaintiffs did not go to another manufacturer when there was delay on the part of the defendants, because the latter were continually promising there should be an improvement in this respect. It was not the appearance of the defendant company's advertisement in the Electrical Review as to the "Queen of Lamps" that first made his company feel irritation. There was no irritation then and there was not now. His company were not undecided as to the marking of the lamps until January. They were quite decided about the matter from the outset, but the defendants pointed out certain difficulties. The "Queen of Lamps" would have served their purpose when the defendants had failed to supply the other lamps, but the "Queen" would have cost them much more than they had agreed to pay the defendants for the manufacture of the lamp specified for.

Mr. Justice Mathew expressed the opinion that the real measure of damage would be arrived at by taking the difference between the price in the "Queen of Lamps" and the price of the contract lamp, assuming that the plaintiffs had gone and purchased the former lamp and put it on the market to the extent in which there had been non-delivery.

Mr. Graham submitted that what they were inquiring into was what damages had in fact been sustained, not, theoretically, what damage had been suffered.

Mr. Justice Mathew: No, indeed, you are not. You are inquiring into what the proper measure of damages is, and I see no better method than the old-fashioned one I have indicated.

In further cross-examination, the Witness stated that his company had not as yet contracted with customers for the supply of English-made lamps, because they were not in a position to do so. They required a large stock to do this, and they had not that sufficient stock which would enable them to open a market in the article, and keep up the supply. He denied that his company caused any delay by the failure to give instructions as to the "capping" arrangements.

Mr. L. Mantell, manager of the National Liberal Club, deposed that an 8 candle-power lamp of the plaintiffs' company gave exactly the same light as the ordinary 16 candle-power lamp. He spoke from experience of the lamps at the Criterion, where the Edison-Swan lamp was superseded by the plaintiffs. The lamps were of German make. It was contemplated changing the lamps at the National Liberal Club in the same way, but as the lamps of the plaintiffs were of foreign make, they were objected to. Mr. Fanta, however, had been told that when he could supply an English-made lamp the change would be carried out.

Mr. Alfred Henry Walton, electrical engineer, agreed with the last witness as to the saving in illuminating power effected by the plaintiffs' lamps, which had been adopted with success at the Empire Theatre. The lamps being foreign made had a shorter life, and witness had told Mr. Fanta he should not give orders for further lamps until the plaintiffs could supply him with the English-made article.

This closed the plaintiffs' case.

Mr. Moulton, for the defence, said that now, practically, the whole of the lamps contracted for had been delivered. That was to say, the 66,000 for which there had been a specification had been delivered, and of the 34,000 the defendants were prepared to give delivery. There had thus been a carrying out of the contract, and if damages could be recovered, it could only be on the ground of delay. What damages had been incurred here? Soon after they had entered into the contract the defendants commenced to deliver the lamps, and although they delivered slowly, still the plaintiffs, at the very time they brought the action, had in stock 16,000. Surely it could not be said that they had not then a sufficient quantity to enable them to commence the sale. The fact was, that they were not selling the English-made article, but a German lamp. The lamp manufactured for them by the defendants was not a lamp which would be sold in large bulks, and when they had 16,000 in stock they might very well have chosen to commence their sale. They had at the present time 54,000 lamps properly delivered, but notwithstanding this they had not even yet commenced the sale. Why should the defendants be made liable to pay damages to the plaintiffs when the latter had made a determination not to commence to sell until something like 60,000 lamps had been delivered? They never gave the defendants the slightest hint that they had come to this determination. As to the question of prejudice, there was nothing whatever in it. Of the "Queen" lamp, out of 4,000 no fewer than 3,700 were 16 candle-power lamps—that was to say, of the very type of which they kept over-delivering to the plaintiffs. That was, he submitted, a complete answer to the charge that the defendants were keeping back the competitor to the "Queen" lamp. He admitted that there had been delay, and the defendants were quite willing to behave reasonably to the plaintiffs on this account.

Mr. Justice Mathew thought that the parties might give their counsel authority to settle the case on the basis of assessing what should be paid by the defendants to the plaintiffs in respect of the delay that had occurred in delivery, and he would then discuss the matter with them.

Mr. Bousfield and Mr. Moulton having got the requisite authority from their respective clients, retired to his Lordship's room to discuss the matter with him.

After a brief absence they returned into Court, when it was announced that it had been agreed that there should be judgment for the plaintiffs for £750 and costs.

Salmony & Company *v.* The Improved Electric Glow Lamp Company, Limited.

In the Queen's Bench Division of the High Court of Justice on Friday, January 28th, the case of Salmony & Co. *v.* the Improved Electric Glow Lamp Company, Limited, came on for hearing before Mr. Justice Kennedy. Mr. Tindal Atkinson, Q.C., and Mr. F. Abrahams were counsel for plaintiffs, and Mr. Rufus Isaacs for the defendant company.

Mr. Tindal Atkinson said the action was brought to recover £287 15s. 1d., being balance due for the supply of electrical fittings and lamps. The defendants had paid £138 7s. 4d. into Court, leaving a balance due of £149 odd. There were no pleadings, and there were only two items in the plaintiffs' account, which was sent in to the defendants, in dispute. One was of £156 13s., and another an item of £67 14s. 2d. Those items related to the sale and delivery of certain holders to fix the glow lamps upon. There was a counter-claim. The defendants said that the goods were not delivered at the proper time, and that when they were delivered they were rejected by the defendants, but ultimately taken into their possession on the terms that they were to act as agents for their disposal. That plaintiffs emphatically denied. They said the goods were supplied within a reasonable time and were accepted. Although defendants demurred in the first instance, the goods were ultimately accepted, and they had used a quantity of them. The payment of £138 into Court, he understood, included payments in regard to the items he had last mentioned, and an item of £75 which defendants said was all that was due on a sale of £100 worth of goods, they having deducted 25 per cent. commission. Plaintiffs said that that was all moonshine, and that they never agreed for defendants to act as their agents in any shape or form. All the goods, in fact, had been ordered by them for themselves. Then there was a counter-claim to recover, as he understood, £700 under these circumstances. In 1895, his clients, who were electrical engineers in Charing Cross Street, had control of the agency for the sale of these silvered lamps. They were little electrical lamps which went into a fitting, and which were silvered on the top side so as to reflect and increase the amount of light. That was an agency for the United Kingdom and the colonies, and

they were agents for a Mr. Schwarber, of Berlin, who he supposed was the inventor. The plaintiffs under that contract had effected some business, and among other contracts they had disposed of some of these lamps to a Mr. Brown, of Eastbourne, and Mr. McLeod, of Glasgow. The contracts with McLeod and Brown were really contracts of agency; that was to say, that these people had agreed to become the plaintiffs' agents for the disposal of the lamps, and they had also become personally liable to take from them a certain quantity of the lamps, and pay for them, and in addition act as agents in their particular districts. A person of the name of Fanta was the promoter of a particular syndicate which was purposing to take over the sale of these lamps in the United Kingdom, and also to acquire the patent rights. He could not carry out that unless he had been appointed agent, and in the latter part of April, 1895, Fanta negotiated for the transfer to the syndicate of the agency which the plaintiffs held. He was informed of the existence of the contracts with Brown and McLeod, and it was evident that it was intended by Mr. Fanta that he should have some considerable object in view to show that the persons whom he expected were to form the syndicate. The result of those negotiations was contained in an agreement, and it was under that agreement, and an assignment which followed, that the counter-claim was made. The company made an assignment of the contracts on December 16th, 1895. Counsel then went into particulars of the various contracts and their construction, and said that under them the company made various claims, one of which was, that plaintiff, was to take no less than 22,500 lamps from them, whereas he had only agreed to take 4,500. That he regarded as an attempt at imposition. One result of what took place was that Messrs. McLeod & Brown refused to be handed over to the syndicate. The parties met, and there was a long discussion and correspondence, which counsel read. It applied to the orders alleged to have been given and repudiated, and to the delay in the delivery of the various appliances which had to be manufactured in the interior of Germany, and shipped from Hamburg. He contended that all that his client's undertook to do was to have the things made and delivered as quickly as possible, and said it was a fact that 2,200 out of the 2,500 holders were received by the defendants in time to be used at the Jubilee. When plaintiffs sent in their invoices they were returned. Their books had been inspected, and there was no trace of any agency or commission accounts, nor any detecting as to goods not delivered according to contract. He suggested that there was really nothing either in the defence or counter-claim, and called Mr. Henry Max Salmony, the plaintiff; but before he gave his evidence he was recalled from the box, and a consultation took place between him and counsel on both sides with a view to arriving at a settlement. There was, however, no result, and plaintiff then gave evidence in support of his counsel's opening statement. He maintained, as had been admitted by the other side that he had fulfilled his part of the contract entered into, and that was the position he now took up. He and his firm did their best to get the goods delivered from Germany in time for the Jubilee, and many of them arrived soon enough to be so used. He had never admitted that the goods were late in delivery, or that he agreed to allow the defendants to retain them and sell them on a commission of 25 per cent. The usual condition of commission for such a transaction would have been 5 per cent.

The hearing was resumed on Monday, and judgment was given for plaintiffs on the counter-claim, and also on the claim, with costs.

Cawte *v.* Penny-in-the-Slot Electric Syndicate.

This was a claim brought before the Taunton County Court by a Taunton electrical engineer for £14 for goods, and £25 for breach of warranty. Early last year the Electric Light Extension Syndicate made arrangements with him to do their free wiring at Taunton. After waiting a good time he found that the company, although obtaining orders there, was not carrying out the work, and when he communicated with the company he was informed that a new company would take over all responsibility and arrange with him. Mr. Cawte did certain work, and the Penny-in-the-Slot Syndicate communicated with him. For the defendants, it was claimed that the company had not taken over the Electric Light Syndicate, and had nothing to do with the plaintiff's claim. They had the option to take over, but did not do so. Mr. Bastian, managing director of the Electric Light Extension Syndicate and the Penny-in-the-Slot Syndicate, gave evidence, and said that the Extension Syndicate were prepared to admit the claim of £14 7s. for goods supplied. The claim was amended, and judgment given for the plaintiff for that amount, the question of damages falling through. Defendants' costs were refused.

Salmony & Co. *v.* Theerman & Co.

In the Westminster County Court, on Wednesday, the part-heard action by Messrs. Salmony & Co., against Messrs. Theerman & Co., electricians, of Manchester, was concluded. The claim was for £8 for a resistance, and the defendants stated that the article supplied was not of the dimensions ordered, and he was only willing to pay £3. The case had been adjourned for the attendance of a witness, Harris Rosenberg, who now gave evidence, that he was one of the plaintiffs, and after the delivery of the machine, he saw the defendant who said he was surprised at its elaborateness, and that it was delivered too late for his purpose, but he would keep it at £3. That he declined to do, and he arranged that he would take it back if he gave them large orders, but the traveller who took the order left them, and being a friend of defendant's, he cancelled all the orders. He only agreed to take it back upon future large orders being paid for, but the orders were all cancelled after the traveller left. The only orders which had been executed were small ones.

Cross-examined by Mr. Wood: The order was to be from 45 to 50 amperes, not 45 only. Nothing was said as to price. Their catalogue was priced up to 30 amperes. The metal was all right; it was made of galvanised iron wire. If it had been made of silver wire and alloy, it would have been much smaller than this one, and lighter.

On behalf of the defendants, Mr. Frederick Taylor, a consulting electrical engineer, of 14, Victoria Street, S.W., said the machine could be made much smaller, and equally serviceable. The resistance would work, but was too large. About £3 to £3 10s. would be the price of a German silver or a platinoid one. He could not expect to get a machine like this from looking at the illustration in plaintiffs' catalogue, from which the order was given.

Cross-examined: Crompton's made resistances, but that was not their speciality. Defendant said he had since bought one of the same resistance for £3, and the weight was 2 qrs., whilst the weight of this one was 2 cwt.

For the plaintiffs, Mr. Duncan Watson, A.I.E.E., said that the resistance was a reasonable one. It was a very substantial one.

His Honour, after a long and patient hearing, found for the plaintiffs, remarking that, it being an unusual size, the price was higher than was generally the case. He allowed £7 for it, with costs.

CORRESPONDENCE.

Refuse Destructors.

My attention was, a few weeks since, called to the discussion which has for some time occupied a considerable space in your valuable Review, and I further note in your last week's issue that my name, in conjunction with Mr. Laws, of Newcastle, and Mr. Yabbacomb, of Bristol, was introduced by a writer who would like to know our opinion upon the destructor question as now before the public. I do not know, Mr. Editor, what the particular views of the gentlemen named may be with respect to making their opinions known; but I do not think I shall be far wrong when I say that, with the individual experience which we have in the working of the destructor, we neither of us care about entering into a public discussion, through the columns of the press, when the principal writers upon the subject at the present time are manufacturers or those who are interested in the sale of some particular form of furnace—every one, of course, claiming premier position for his particular pet; or may I add another class? I do so with much hesitation, and it is from your correspondence I arrive at the opinion: those who, perhaps too anxious to become great benefactors to their fellow ratepayers, and so earn their everlasting (parochial) gratitude, further some scheme, which may or may not succeed, become anxious about the success of their *protégé*, and, I may say, angry with those who appear, in all good faith, to differ from them.

Some five-and-twenty years ago we used to joke about the "golden dustman." But this gentleman has passed away. The place that knew him once—to wit, say, Paddington—knows him no more, and instead we have the "Golden Dust-bin"—sanitary, of course—in fact, to go through the correspondence which comes to hand daily through the favour of that invaluable institution of modern days, the Newspaper Cutting Agency, it would appear that, thanks to the inventive genius of our destructor makers, the "age of gold" has dawned upon us, and a veritable Klondyke is at our back doors.

So far as my individual opinion is concerned, I was under the impression that that was pretty well known, having erected the first destructor built in the South of England in 1882-3 (the second was Southampton in 1886). I at once utilised it as a steam producer, and have continued to do so up to the present time, and a most valuable adjunct to the sanitary appliance of Ealing it has been during all these years; dealing not only with the house refuse, but with the *sewage sludge* of a continually growing population, and that without the slightest difficulty or nuisance in any way. As is well known, the Ealing destructor is of the "Fryer," or low temperature type, assisted by my "Fume Cremator" of 1885, and which, notwithstanding Mr. Watson's criticism in the lecture at Gloucester, most certainly made the "destructor possible." These words are not my own, but were used by Mr. Laws in the paper he read at the International Congress of Hygiene (London) 1891, and I cannot help saying that it does strike me as somewhat strange that between the years 1885 and 1897 so little has been done by our engineering world in the way of supplying a really useful and economical

apparatus for dealing with the question of house refuse. In making this remark I do not for one moment seek to depreciate the high temperature installation, nor suggest that Mr. Watson and others who are advocating their particular furnaces are acting other than in all good faith; on the contrary, I am free to confess that I am always deeply interested in the work being done, and particularly the statements which ever and again find publication from the pen of Mr. Watson, but nothing that I have yet heard, seen, or read has led me to change my opinion that for general use the inexpensive low temperature destructor, such as the "Fryer" of Manlove & Co., or the "Perfectus" of Goddard, Massey, and Warner, are other than the most suitable.

One of your correspondents refers to the statistics in my book on "Refuse Destruction," 1894, making particular reference to Table A., "Towns of England," where, out of a number of towns given as 1,005, 863 were under 25,000 inhabitants, and probably a very large proportion of these have no call for "power," although they may make a valuable asset of a well-burnt clinker and the ash from the hearth for building purposes. No doubt the view I take of them as a municipal officer is primarily the necessity for getting rid of a universal nuisance (house refuse) in a simple and efficient manner; the question of profit is a secondary one, and from this point of view, in my humble opinion, the low temperature furnace is the most likely to accomplish the object and meet the necessities of not the large towns, maybe, such as Leeds, Oldham, and similar centres of very large population, but of the towns which, comparatively insignificant when compared with the above, still just as much require the application of fire to deal with their sanitary nuisances.

Reference has, I know, been made again and again, in the general discussion of this question, to the supposed failure of the Edinburgh destructor. It may appear somewhat venturesome to state that, in my opinion, the Edinburgh destructor was not a failure, and this I do notwithstanding the fact that the Horsfall Company was called in to alter it. I visited Edinburgh twice, at the request of the Corporation, and from exhaustive examination I came to the conclusion that the fault was not in the destructor, but in the mode of working it. A guarantee had been given to destroy a certain number of tons per 24 hours, and the quantity was got through, with the result that the residue was not good hard burnt clinker, but a soft three parts burnt material, certainly unsatisfactory in its result. The experience of Mr. Yabbacomb at Bristol was very much the same; in his paper read at the meeting of the Municipal and County Engineers, September, 1896, referring to the work of the destructor ("Fryers") he says: "That by working all seven days, the amount specified in the contract with the manufacturers could be just reached; but the clinker was of a soft inferior character, through the fires being drawn too rapidly." Subsequently Mr. Yabbacomb applied a steam blast, with the result, a higher temperature, an increased consumption of refuse, 7⅓ tons per 24 hours, together with an improved clinker, a conclusion I consider in every way satisfactory, and going to prove that, with careful working, an every-day result of a most satisfactory character may be obtained from the comparatively inexpensive low temperature furnace of the "Fryer" class, even when worked in the most moderate "work-a-day" mode.

I am quite aware that from the contractor's and patentee's point of view the low temperature furnace, even when a fan is added, is not a success; there is no special profit to be made out of these, and no patent fees; anyone is at liberty to build them, and for a few hundred pounds an installation equal to the ordinary necessities of a small town population can be erected; in making these remarks, I would again repeat that I am dealing with the smaller towns, and not with the large centres of population. At the same time, having erected the majority of our cells at Ealing without a contract and with our own men, I know the exact cost of construction.

With respect to the Shoreditch destructor, or "universal utiliser," as it has been termed, I can only say that I am content to wait; there is an old saying that "It is never safe to prophecy unless you know," and I cannot help thinking that very much of the feeling engendered in the minds of the Shoreditch chairman and others, has just been the result of "premature prophecy." So far as "thermal storage" is concerned, there is nothing particularly new about that; but its application to destructor purposes is new and interesting. To me, personally, I may say it is especially interesting from the fact that some years since Manlove, Alliott & Co., called my attention to the scheme, and I went into the matter with a view to its application at Ealing, but upon full consideration of the cost to be incurred, with the probable results, I came to the conclusion, to use a common phrase, that the "game was not worth the candle;" but in all fairness let me say that a scheme which might not be suitable for Ealing with its then 25,000 population, might develop results quite different in a district like Shoreditch with its 124,000. Should it succeed I shall be the first to "take off my hat," and acknowledge its merits, indeed, I think I may say that I will do so if it only accomplishes *one half* of the prediction made in its favour at its birth. I do not mean at the banquet, Mr. Editor, that would hardly be fair, you know, but rather between the times when the good Vicar of Shoreditch "read an appropriate dedicatory prayer," and the hour when "the light of other days" was turned down, and amidst the hearty applause of the company the chairman switched on the "light of the future." I am copying from printed account of proceedings.

I have no doubt that ere long a clear and exhaustive account will be forthcoming, showing the Dr. and Cr. state of the whole affair. I should have concluded this somewhat lengthy letter at this point, but for the fact that the morning post brought me in unmistakable print the announcement of another wonderful discovery in the destructor world. *London* informs me and all its readers that "Leyton is again distinguishing itself." In large letters we are informed that "The First Sludge Destructor" has been erected: "A Difficult Problem Solved by the Leyton District Council—A Combined System for Destroying Sewage Sludge as Well as House Refuse," and further, that the council has "proved that the sludge can be burned like ordinary house refuse," and further, that "on the advice of the surveyor, Mr. Wm. Dawson, the District Council made the first attempt *ever tried*, and the result of 15 months' working is sufficient to justify some show of pride." *London Argus* contributes similar information. I read these extracts at first with some amusement, it looked like a monstrous joke on the part of the surveyor to the Leyton District Council, but I took up another cutting and found that Sir Douglas Fox and Francis Fox had reported as follows: "So far as *we* are aware, it is the only form of furnace yet adopted, capable of burning a considerable portion of sewage sludge even when containing as in this case, a high percentage of moisture," and after reading this, I could not but feel ashamed for any professional man, shall I say brother municipal officer, who could allow such absolutely misleading and erroneous statements to go forth to the public, and I am sure that the same feeling will fill the minds of one-half of the municipal engineers of England, when they read them. I was under the impression that I had been burning the sewage sludge of Ealing with the house refuse, ever since 1883, and that most of the municipal engineers of England knew it, I thought that the Ealing works, visited by hundreds of visitors from not only England but from all parts of the world, had one speciality, viz., *burning the sewage sludge*. I was under the impression that the late eminent scientist, Dr. Meymott Tidy, in a lecture at the Society of Arts, April, 1886, said: "To my mind the destructor has reached its highest state of perfection at Ealing from the great thought the surveyor, Mr. Jones, has given to it. The sludge is there mixed with house refuse and burnt. Mr. Jones's view is that every town produces sufficient house refuse to burn the sludge." I thought that in the discussion that ensued upon the reading of Mr. Dibdin's paper on "Disposal of Sewage Sludge," before the Institution of Civil Engineers, as long ago as 1886, the subject of sludge burning was well threshed out, and stranger still, I was under the impression that the surveyor of Leyton—a member of the Incorporated Association of Municipal and County Engineers, of which I have the honour of being a past president—knew the Ealing works well, with all their specialities. All the above only goes to prove how strangely one may be mistaken.

I have upon my recollection the fact that *London*, to which I have referred, among the other items of interest

respecting Ealing, says (April, 1895): "It (Ealing) discovered that the proper treatment of its dust and sewage not only gave health advantages such as no neighbouring area possesses, but placed at its disposal what might be called advantages for securing other advantages. *The collected refuse, which is mixed with the sewage sludge and consumed in the destructor cells, and the fume cremators produce tremendous heat, a portion of which had already been used to raise steam for driving the engine of the sewage works, &c.*"

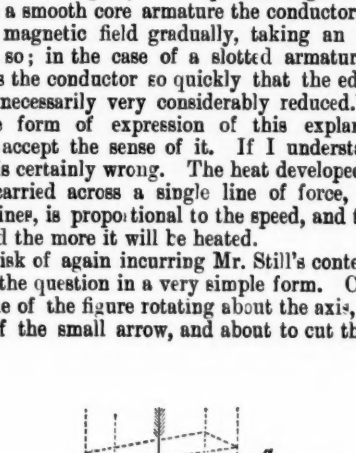
Mr. Editor, I had no intention of so extending my remarks, and I have omitted to touch upon many interesting details, as to residuum, cost, &c.; but reading at the last minute the details concerning Leyton, has led me into a somewhat extensive communication, for which I must apologise.

Charles Jones, M.I.C.E., F.S.I.

Ealing.

Mr. Alfred Still, in your issue of last week, observed that I, not understanding how it is that a buried conductor is free from eddy current heating, had "missed the point." This is perfectly true, and my desire to find it was largely my reason for stating so precisely the mechanism of the action of a slot-wound conductor. But Mr. Still does not assist matters by repeating an unsatisfactory explanation. He says, "surely we are right in assuming that, for a given E.M.F. generated" (I presume in the main dynamo circuit), "the eddy current loss in a conductor depends upon the time which it takes in passing into or out of the uniform magnetic field under the poles." I think we certainly are justified in the assumption, but if the conductor is moved faster into the field the eddy current loss is thereby increased, not diminished. Again, "the explanation given being that whereas in a smooth core armature the conductors enter and leave the magnetic field gradually, taking an appreciable time to do so; in the case of a slotted armature the lines snap across the conductor so quickly that the eddy current losses are necessarily very considerably reduced." He disclaims the form of expression of this explanation, but appears to accept the sense of it. If I understand what is meant, it is certainly wrong. The heat developed in a mass of metal carried across a single line of force, or isolated group of lines, is proportional to the speed, and the quicker it is carried the more it will be heated.

At the risk of again incurring Mr. Still's contempt, I will try to put the question in a very simple form. Consider the metal frame of the figure rotating about the axis, P Q, in the direction of the small arrow, and about to cut the magnetic



field shown by the dotted lines. Current will be generated in the circuit, *a b c d*, analogous to the eddy currents in an armature bar, while current generated in the frame, A B C D E F, is analogous to the main dynamo circuit. The electromotive force in the dynamo circuit due to the movement of the compound bar, B C, is the mean of the forces generated along *a b* and *d c*; and the electromotive force in the circuit, *a b c d*, is the difference of the forces along *a b* and *d c*. For the discussion of eddy currents suppose the main circuit to be open, and consider the passage of the closed circuit, *a b c d*, across the field. If *n* lines of force are threaded through a closed circuit at an uniform rate in a time, *t*, the heat developed is proportional to $\frac{n^2}{t}$, and increases with the speed. In a slot wound armature the bars never enter a strong field at all, and *n* is exceedingly small.

On the other hand, it is not necessarily the case that the bars pass from the interpolar space into the maximum or uniform field more quickly in a slot wound than a surface wound armature. If the two revolve at the same speed, and in fields of the same form, the time occupied in passing into the field will be the same. But in a slot wound armature the gap between the iron surfaces is less than in a surface wound armature, the fringing is less, the bar enters the field more suddenly, and the heating is to that extent increased.

Mr. Still's explanation appears to me to show that slot wound conductors should heat more than surface wound conductors.

The solution of the difficulty lies clearly in the small intensity of the maximum field, not in the rate of speed at which the bars enter that field.

As to my paradox. Mr. Still's case is not parallel at all. A dynamo when running is a seat of electromotive force, not necessarily a source of current; and our conception of its action is not dependent on its always producing current. A magnet, on the other hand, is not a seat of magnetic force, but a source of magnetic flux, and we have no conception of its existence other than as giving rise to magnetic flux. The question is this: Place a permanent magnet, *i.e.*, a body whose sole property, in so far as it differs from a piece of hard steel, is that it is a source of flux, in a position where no flux is possible. What happens? The consideration of a dynamo running, but not generating current, does not bear on the point.

W. A. Price.

Is an Electric Traction Engine Subjected to Shocks, or is it Not?—Raworth v. Emery.

In your issue of October 29th, 1897, you published a letter of mine criticising Dr. Emery's article on "Engines for Electric Railway Power Stations," which appeared in the *Street Railway Journal* of the same month.

With this letter of mine the *Street Railway Journal* was deeply grieved, and in its December number devoted more than a column to the expression of its sorrow that an English engineer should have chosen to write in an ill-natured way about a purely technical subject, and should have attempted to arouse personal or international prejudices.

Of course, nothing was further from my mind, for some of my best friends engaged in the engine trade are Americans, and I regret as much as the *Street Railway Journal* that my letter was open to any such interpretation, and especially do I regret now that we are informed that Dr. Emery is an international authority on the steam engine, that I took the liberty of criticising his literary peculiarities; and I feel sure Dr. Emery, with the usual breadth of mind of an engineer, has already forgiven me.

Dr. Emery has written a letter, in which he endeavours to defend his position, and to destroy mine; I, therefore, propose to submit his arguments to the judgment of your readers.

The original article stated, concerning an engine for electric traction: "Its entire construction must be proportioned to the racking due to continued repetition of shocks," to which I replied: "This oft repeated fallacy would be amusing, were it not for the fact it is too often believed, and worse still, acted upon, whilst all the time the fact remains that *there are no shocks and no excessive strains.*"

Now for Dr. Emery's arguments:—

First, he says I "must know that if a dynamo directly connected to an engine be short-circuited, its speed is naturally checked by a load applied with lightning rapidity. Necessarily the fly-wheel tends to twist the engine shaft, and all the moving parts are brought up with a shock, instead of being changed in direction smoothly by a crank motion."

I am sorry to say that the doctor presumes too much on my knowledge. I certainly do not know "that a short circuit tends to twist the engine shaft," although I am quite willing to admit that it tends to twist the dynamo shaft and the coupling.

Further, I do not know "that all the moving parts are

brought up with a shock instead of being changed in direction smoothly by a crank motion." No short circuit ever did or ever will bring up an engine in less than half a revolution.

I hope this statement is quite clear. I do not wish to take refuge behind any ambiguities.

Dr. Emery then proceeds with his second argument:

"Again, in releasing a load suddenly, the elasticity of the parts and their weight also produce shocks, as every piece of metal transmitting the load is, within certain limits, a spring."

When the Doctor penned this sentence he evidently forgot that the throwing off of the electrical load does not open the exhaust valve of the engine, and that, therefore, the parts continue under the stress of the steam pressure until the end of the stroke, when they are "smoothly changed in direction by a crank motion."

The above are all the arguments Dr. Emery adduces which are applicable to English electric lighting or traction engines. He concludes, however, with one which applies to some American engines, though not to those which have been sent to this country:—

"Again, if there be any side strains due to overhanging cranks not balanced in one bedplate, the amplitude of the lateral movements caused thereby will be proportioned to the time in which the maximum force is applied; that is, they will be greater for heavy loads than for light ones."

Here again the Doctor is wrong.

It would be a very bad engine that moved laterally $\frac{1}{16}$th of an inch; therefore, with a cut-off of even $\frac{1}{10}$th, there is ample time for the full movement to occur, and, as a matter of fact, anyone with eyes may see the result for himself; at every stroke, on the opening of the admission valve, the cylinder goes over with a snap, there is no appreciable time element.

It is rather unfortunate for the other side that they have got such an honest advocate as Dr. Emery, who has tried to rake up every plausible looking argument in support of their theory, for we now know the nakedness of the land; we also know that the lean kine are eager to eat up the fat kine, and they will do it if we do not bestir ourselves.

The *Street Railway Journal*, in its backing up of its contributor, goes one better than Dr. Emery. It says:—

"It was no unfrequent occurrence to see an engine brought up standing by a heavy load suddenly thrown on with the starting of a number of cars."

Now, what does the phrase "brought up standing" mean? Most electricians are aware that, as the speed falls, the volts fall also, and that the engine will still run at a reduced speed. If the *S.R.J.* means to convey the impression that the engine stops dead, then I say it has been dreaming, if on the other hand it simply desires to indicate that the engine was too small for its job, why does it not reproduce Mr. Philip Dawson's paper for the education of its readers?

John S. Raworth.

Electro-Motors and Fire Office Rules.

The latest rules issued by the Fire Office Committee, a representative and executive body, imposes restrictions upon the construction of electro-motors which, if not modified, will seriously interfere with their use. In fact, the new rules seem to favour one type of electro-motor to the degree of being a broad advertisement for it.

The rule in question enjoins that a "fireproof case which shall form part of the designed construction of the motor itself, and not be an added movable covering," shall in all cases be used. Electro-motors enclosed by a case forming part of the stator are necessarily hampered in construction and of less efficiency than those of ordinary make. It is fair to suppose that the Fire Committee have in view the extreme inflammability of minute particles, especially of organic matter, such, for instance, as floar dust. In a well constructed and carefully tended motor, the ordinary sparking is not sufficient to ignite such particles, and in the case of a short circuit the motor would come to rest long before any part of the burnt-out insulation could be spread by centrifugal force.

Again, in applying electro-motors to the direct driving of machines of small power, the enclosure of the whole in a case not only renders the mechanism more subject to derangement, because a single fault is not observed at the time of occurrence, but also conduces to excessive heating by checking natural ventilation. This is most important in the case of intermittent loads as a free current of air tends to keep the varying temperature within a certain safe limit. A movable box with mica lights may be used in certain cases to enclose the commutator, but in the event of excessive sparking, this method is more dangerous than the ordinary open working, since the confined space would, after some time become filled with infinitely finely-divided metallic particles, the natural result of attrition, finally causing a revolving arc to be formed, quickly destroying the motor, and probably causing a destructive fire.

As small electro-motors are favourably received by manufacturers and the public generally wherever an electric service obtains, it is a pity that the electrical trade should be checked in this direction by the introduction of rules which may be modified without increasing the fire risks.

The Fire Committee, as a representative body so far as the fire offices are alone concerned, do not represent the public, or the electrical trade, and evidently require technical assistance when making their rules.

Fredk. Walker.

February 2nd, 1898.

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—A receiving order was made last Tuesday, at the London Bankruptcy Court, against John Dewhurst, electrician, &c., 52, North End Road, West Kensington. The debtor presented his own petition, and an order of adjudication was also made by the Registrar. No particulars transpired regarding assets or liabilities.

Electrical Work in Natal.—We understand that Messrs. Mowat & Still, of Pietermaritzburg, Natal, in view of the amount of electrical work now coming on in that city, have opened a branch in their extensive business for electrical engineering, under the management and advice of Mr. Oswald R. Swete, A.I.E.E. (vice-president of the S.A.Soc.E.E.). We understand that the firm are open to receive the latest catalogues of electrical fittings and other appliances.

For Sale.—In an "Official Notice," will be found particulars of two sets of secondhand electric lighting plants, which are offered for sale by the City Electrical Engineer at Liverpool. The plants are suitable for a large and small private house respectively.

Messrs. Montagu Kent & Co., will on the 10th inst., sell by auction, various electric light plants, dynamos, boilers, steam and gas engines, shafting, lathe, planing machines, one electric and three steam launches, at Strand-on-the-Green, Chiswick. See our "Official Notices."

Hospital Lighting.—The Metropolitan Asylums Board have decided on the recommendation of the Northern Hospital Committee to engage an engineer, or a firm of engineers, to prepare a scheme for lighting the hospital, and to draw up specifications, plans, &c. Messrs. Burstall & Monkhouse have already reported upon the cost of electric lighting plant, which they estimate at about £10,350.

Liquidation Notices.—An account of the winding up of the Guattari Power Syndicate will be placed before the shareholders by Mr. A. J. Bale, liquidator, at a meeting to be held at 120 and 122, Newgate Street, E.C., on Tuesday, March 1st, at 2 o'clock.

At meetings of the National Company for the Distribution of Electricity by Secondary Generators, held January 11th and 28th respectively at 2, Warwick Street, Regent Street, W., resolutions were passed winding up voluntarily, and appointing Mr. J. H. Thornton, of Winchester House, E.C., liquidator.

The Affairs of an Electrical Company.—On Wednesday, before Mr. Justice Wright, sitting as an additional judge of the Chancery Division, among the winding-up petitions which appeared in the list was one in the name of Mr. H. O. Ruelle, relating to the National Company for the Distribution of Electricity by Secondary Generators, Limited. On the case being reached, Mr. Rowton said this was a creditor's petition. The matters at issue between the company and the petitioner were the subject of litigation before Mr. Justice Stirling. They were before him on last Saturday week, and on an intimation from his Lordship, certain terms were then arranged, which included that the petitioner should adjourn the hearing of the present petition. He had, therefore, to ask that the matter should stand over generally, with liberty to apply for it to be restored to the list. His Lordship granted the application.

The Electrical Metal Working Syndicate, Limited.—We are informed that Messrs. Scott Anderson & Beit, of Royal Insurance Buildings, Sheffield, have been appointed sole agents for the Voltex process of electric welding, brazing, &c., for the following

counties:—Yorkshire (south of a line through Whitby, Northallerton and Richmond to Kirkby Stephen), together with the entire counties of Lancashire, Nottingham, Derbyshire, Staffordshire, Cheshire, Worcestershire and Warwickshire.

Water Power on Tender.—The chief Engineer for Irrigation, Madras, is inviting tenders, by order of the Secretary of State for India, until July 1st, 1898, for the utilisation of water power of the Periyar Lake.

ELECTRIC LIGHTING NOTES.

Bath.—The bill for the quarter's public electric lighting amounted to £516, and when this was before the Surveying Committee last week Alderman Sturges drew attention to the deduction of £27 for 108 failures at 5s. This he said did not mean that there had been 108 distinct failures in the lamps, but that on one occasion through a fault in the machinery a whole line of lamps went out. Was it a righteous thing, he asked, to deduct for 108 failures under those circumstances? The bill was passed without the deduction.

Bedford.—Consumers are agitating for reduced charges for current and lower meter rentals. The Electric Light Committee is to report on the desirability of constructing a refuse destructor at the supply works.

Birkenhead.—The Electrical Committee submitted to the Council, on Wednesday, a report dealing with their department. This report states that in February, 1894, the Council appointed Mr. James N. Shoolbred, M.I.C.E., as electrical engineer and adviser, and the supply of electrical energy commenced in September, 1896. Since, the undertaking has proceeded somewhat slowly, but on the whole satisfactorily. An index of the progress is afforded by a table showing the number of consumers during the quarter ending December 25th, 1896, and the quarter ending December 25th, 1897, the figures being—Consumers, 66; and current in units, 23,543, during the latter quarter, as compared with 23 and 6,635, the figures for the first quarter of the undertaking. A sub-committee has considered the constitution of the present electrical staff and the possibilities of the more rapid development of the undertaking, and the supply of energy for power as well as lighting, especially in connection with the working of tramways, and the result of their consideration is a recommendation to dispense with the services of the consulting engineer on the completion of the various contracts under his supervision, and to appoint a resident electrical engineer, at £300 per annum, to direct the further development of the electrical supply.

Birmingham.—In a recent report the Gas Committee make some remarks regarding the past and prospective effect of electricity supply upon the gas consumption. They consider that there is nothing to suggest that "it will not be necessary" to extend the gas works in order to meet the demand. The total sale of electricity in Birmingham, in 1896, is given at "not more than equivalent to a sale of 60,000,000 cubic feet of gas as ordinarily used for lighting purposes. This would not, even if it had all been used in substitution for gas, displace plant for the production of more than 350,000 cubic feet of gas per diem. The electric lighting of the Market Hall has only diminished the consumption of gas registered in that building from 8,600,000 to 6,900,000 cubic feet per annum. The greatest daily output of gas in Birmingham in 1896 was over 33,000,000 cubic feet, and the total sale in the year was 4,859 million cubic feet. The effect of the competition in Market Hall Ward, where electricity has met with the largest sale, shows a slight decrease in the sale of gas for 1896, as compared with 1892, but an increase in 1897 over 1896 of 3·6 per cent. in the central area, and 13·6 in the rest of the ward. In other large towns and cities where electricity has made progress, an increase has taken place in the gas wanted, this being shown by figures."

Blackpool.—The need for extending the Corporation electric lighting system was before the General Purposes Committee last week. It was stated that the present plant was all taken up. They had no reserve, and the committee could not undertake to supply any more customers, although they had many large applications, including the new Alhambra, the Hotel Metropole, and the arc lighting of several more streets in the town. It was proposed to spend another £40,000, and to put down a new engine of great capacity. Several of the members complained that sufficient time had not been given to carefully consider the matter and the electrical engineer's suggestions. The Committee approved of the expenditure. It was stated that the necessary machinery had been provisionally secured, as engineering firms would not undertake to fulfil further orders in less than two years.

The Town Council on Tuesday adopted the proposed scheme for the extension of the electricity works at a cost of £40,000. Application is to be made to the Local Government Board.

Bradford.—The shops and warehouses comprising Borough Mills, Manchester Road, are now supplied with the electric light from a special plant which has just been put down. There are about 30 tenants on the premises, and provision is made for about 1,000 16-C.P. lamps. The installation, which was put in by Messrs. A. J. Harris & Co., comprises two dynamos, each to supply 350 lamps, and 55 Epstein cells, for 400 lamps. It seems that a company works the concern, each consumer taking a share in it, so that the cost should be very low. The cells are charged by a motor transformer during the day.

Bristol.—A Local Government Board inquiry was held on Tuesday into the application for a £23,000 loan for the extension of street lighting in the city. It was asked that the sanction should be given as speedily as possible, as it is desired to push on with the scheme.

Burnley.—A Local Government Board inquiry was held last week *re* an application by the Corporation to borrow £25,000 for electric lighting. The Town Clerk said that four years ago the electric lighting installation was started, and the loans already sanctioned amounted to £29,756. With the additional borrowing powers they would be able to extend the plant and the mains into the out-districts of the borough.

Cardiff.—A Local Government Board inquiry has been held into the Council's application for a £29,500 loan for electric lighting. Mr. Applebee, the electrical engineer, showed the progress of the undertaking, for which £59,835 had been borrowed, and he explained the extension proposals.

Colombo.—The Indian papers give particulars of the proposal of Messrs. Boustead Bros., which has been accepted by the Colombo Municipal Council, for the electric lighting of Colombo. The firm will replace 548 gas lamps by 548 60-C.P. incandescent electrics, erecting lamp-posts, overhead mains and feeders, &c., &c., for Rs.25,000 (or Rs. 45·62 per lamp), or an annual payment of Rs.2,250. Current will be supplied to the lamps at the rate of 200 hours per month including renewals, maintenance, &c., &c., for Rs.30,000 per annum, which is about 15 cents per unit, or Rs.54·74 per lamp per year. The contract is for five years, after which the municipality can take over the street installation at a valuation. Private consumers will be charged not more than 50 cents per unit (7½d.). The engineers have a sly dig at the City of London Electric Lighting Company, for they add "In the City of London a company has the monopoly of supplying current at 8d. per Board of Trade unit." Yet even at Colombo it can be profitably done for ½d. less!

Crieff.—Mr. Yorke's proposals *re* electric lighting were again before the Town Council last week, and there was a discussion on various points, but the matter was delayed until a conference between that gentleman and the Council could be arranged for obtaining further information.

Darfield.—A special meeting of the District Council will be held on March 4th, to decide whether to apply for an electric lighting provisional order.

Dundee.—Panmure Street Congregational Church has been lighted by electricity, the congregation subscribing the money.

Edinburgh.—The street lighting extensions, to which we referred last week, have been agreed to by the Town Council.

Edmonton.—The Board of Guardians' Works Committee is to report on the advisability of supplying the electric light to the Edmonton House and Chase Farm Schools.

Exeter.—In a report to the City Council a Committee state that they have no data on which to estimate the cost of electrically lighting the main streets, but inasmuch as part of the first cost of arc lamps and posts would have to be paid, and the positions of some of the lamps were to be changed, they had allowed for an increased estimated expenditure of £400.

The electric lighting undertaking is going on satisfactorily. The number of lamps has increased from 7,400 to 10,000, and orders are coming in faster than they can be supplied.

Finchley.—Up to the present the Council has refused to support any electric lighting scheme, but they have now informed a correspondent that they will give careful consideration to any proposal he may make.

Hull.—The electrical engineer, Mr. Barnard, has submitted the following estimate of income and expenditure during 1898:—Expenditure: Generation of current, £3,100; distribution of current, £350; repairs, renewals, and maintenance, £1,100; management expenses, £1,175; insurances, £150; rents, rates and taxes, £950; interest on capital, £1,985; payments to sinking fund, £1,470; balance, being profit, £970; total, £11,250. Income: Sale of electricity, £10,830; meter rates, £420; total, £11,250.

Ilford.—The Council is to approach the Great Eastern Railway Company with a view to the purchase of a piece of land adjoining Sylvan Road for an electricity works site.

Kendal.—In December the Council decided to communicate with experts in gas and electric lighting matters on the lighting question, but as nothing has been done there is a feeling that there has been unnecessary delay on the part of the Gas and Water Committee. At the last Council meeting it leaked out that the electric lighting matter had lapsed through inadvertence. Letters had been received from experts, but had been misplaced and could not be found. The Town Clerk is communicating with the experts again.

Leamington.—The Midland Electric Lighting Company, Birmingham, are stated to have unconditionally withdrawn their Bill for power to light the Borough by electricity. Some time ago the Corporation commenced the promotion of a Bill on similar lines, and it is now stated that the Midland Electric Lighting Company have withdrawn in order that they may be the better enabled to oppose the Corporation scheme. The company have large works in Wise Street, but up to now the demand for electricity has not been by any means equal to the supply. It is stated that the cheap rate at which gas is supplied has militated against a general adoption of electricity in the Borough.

London, E.C.—The Court of Common Council has referred it to the Streets' Committee to consider and report forthwith as to the desirability of applying to the Board of Trade for an electric lighting order to enable the Corporation to supply electric light within the City from a station to be established by themselves or otherwise; and also to report as to the practicability of generating electricity from steam raised by burning the City's refuse in specially constructed furnaces in such proposed electric light station.

Merthyr Tydfil.—The Board of Trade has revoked the 1896 electric lighting order, as and from January 24th, 1898.

Penzance.—The Municipal Electric Supply Company has laid a scheme for lighting the town before the Council. The idea is for the undertaking to be "substantially municipal," the entire responsibility of capital expenditure resting on the company until the Council takes it over. The same system as employed at Brighton is suggested. Referred to the Lighting Committee.

Peterborough.—The Board of Trade has sent to the Council for any observations which they may wish to offer, a description of the system in the form in which the Board propose to approve it, subject to their regulations for securing the safety of the public, and for ensuring a proper and efficient supply of energy. The system to be adopted is described as follows: For general purposes. A continuous current direct supply at constant pressure, and the three-wire system, the mains being partly continuously insulated cables drawn into iron pipes or earthenware conduits, and partly bare copper conductors laid in earthenware or concrete conduits. The Lighting Committee has adopted the Board's suggestions. The application of the Peterborough Electric Light and Power Company for a provisional order is being opposed.

The Local Government Board inquiry will be held on Tuesday, February 8th, regarding the £15,000 loan. This is the second inquiry.

Shoreditch.—At the Vestry on Tuesday last Mr. H. E Kershaw, Chairman of the Electric Lighting Committee stated:—"That owing to the unprecedented success of the Vestry's efforts in the combined scheme of the generation of electricity from the steam supplied by the dust destructor, the Committee recommend the Vestry to reduce the charge for electricity from 6d. per unit for the first two hours and 4d. per unit for the surplus, to 6d. per unit for the first hour and a half and 2d. per unit afterwards. This will work out to consumers of electricity using the light for three hours per day at 4d. per unit, four hours per day at 3½d. per unit, six hours per day at 3d. and so on reducing the cost in proportion to the number of hours the light is in use. This, I believe, is a record in municipal electric light undertakings. After existing for six months only, we are supplying electricity, within a little, as cheaply as any municipal installation in the country. During the past quarter we have sold 95,000 units of electricity, and the engineer's estimate for the current quarter is 150,000 units. The Committee feel extremely gratified that their efforts have been attended with such marked success, fully justifying what has been repeatedly termed a most expensive and dangerous experiment, and for the benefit of the many municipalities who are watching this scheme, though we do not feel called upon to issue our statistics until the end of the first financial year (June 30th) we are satisfied that our expectations will be more than realised, and the success of the joint scheme most *thoroughly established*." After discussion the Vestry resolved to defer the Committee's recommendations till after the financial year's statement in March.

St. Albans.—The Herts County Council will oppose the St. Albans Electric Lighting Order, 1898.

Ventnor.—Plans for the electric light station in Newport Road have been passed by the Council.

Walsall.—A Local Government Board inquiry was held on 28th inst. into the Corporation's application for borrowing certain monies, including £7,000 for electric lighting. The Town Clerk, referring to the growth of the electricity undertaking, said that in 1896 there were lamps of 5,704 C.P. connected, but in 1897 there was the equivalent of 8,195 C.P. The increased demand necessitates an increase in the size of the engine room, and to put in one 250-H.P. engine and a dynamo. There will also be two additional transformer stations, mains, &c., and the present capacity will be doubled.

Watford.—In February, 1894, the Local Board gave Mr. F. Downer permission to carry an electric wire from his etching rooms to his private residence. It is understood that Mr. Downer is supplying a neighbour with current, and the Electric Lighting Committee now recommends that he be requested to give an undertaking that he will limit the supply of electric light to his own premises as soon as the Council is prepared to supply the light.

West Hartlepool.—A site has been secured for the electricity works, in the vicinity of the paper works. The low tension continuous current system has been adopted.

Westgate-on-Sea.—The application of the Isle of Thanet authorities for an electric lighting order is being strongly opposed as regards Westgate-on-Sea.

Wigan.—Before proceeding with the electric lighting scheme, the ratepayers within the proposed area are to be canvassed.

Willesden.—The application of an Electric Lighting Committee for a provisional order is opposed by the Council.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Argentine.—The rumour that appeared in some of the London papers to the effect that the directors of the Anglo-Argentine Tramway Company were contemplating the adoption of electric traction, is contradicted by the *Review of the River Plate*, though that journal considers the company will have to move in that direction before many years have passed, or lose their traffic.

Bradford.—On Wednesday the Tramway Committee met to deal with tenders for rails, paving, electric wires, cars and car-sheds and all the other appliances needed for the electric tramways.

Bristol.—On 26th ult., the Bristol Tramways and Carriage Company's Parliamentary Bill authorising the use of electrical power was laid before the shareholders, and unanimously approved. Correspondence which had passed between the Council and the company respecting the former body's proposal to purchase the undertaking was read. Mr. G. H. Low, the chairman, in going into the matter of electric traction and the advisability of employing such on the proposed extensions, said that several of the contemplated extensions were to traverse roads which were so steep as to make them practically inaccessible for horse tramways, but with electricity they could deal with districts hitherto unprovided for. He referred to the company's relations with the Corporation in 1896, *re* the supply of electric power for the tramways, since which date the gentlemen who took a prominent part in endeavouring to force their supply of current upon the company, had been assuring the ratepayers that come what may they must have electric traction. On the point of the overhead trolley system being the most practicable form, there was no difference of opinion between the company and a majority of the Council. The company was not seeking to enter into competition with the Corporation, but, he proceeded, "we, having an established business, are simply asking for authority to carry on our business and for the purposes of running the remainder of our cars by electricity, to generate and apply our own electricity, as we are already doing in connection with the working of seven or eight miles of tramway within the city of Bristol. We are at the present moment generating for our own purposes at a station within the city and county of Bristol more electrical current than the Corporation turn out for the whole of their customers and their street lighting, and we have the plant there already installed to enable us to make a much larger output. In addition, we were only last session authorised by Parliament to convert our extensive depôt at Eastville into a generating station, and we propose to acquire waterside premises at Counterslip also for the purposes of a power station. I do not believe for one moment that a Parliamentary Committee will prevent the citizens of Bristol from securing the advantages of electric traction over the present horse lines simply because another trading concern, namely, the Corporation of Bristol as owners of lighting works, put forth a plea that we should be forced to bolster up their undertaking as a condition to this improved form of traction being given to the public. So far as your directors are concerned, they are as determined as ever in their intention to resist to the uttermost such an attempted interference in the company's business, and no circumstances have occurred since our original decision on this point to weaken us in the slightest degree, but rather to the contrary." Regarding the purchase question, he remarked that the right of purchase by the Corporation arises in connection with the horse lines about 15 years hence, though as to the main portions of the electric lines there is no right for 21 years.

Crewe Light Railway.—The Cheshire County Council and the Crewe Town Council appeared in opposition to certain of the clauses proposed by the British Traction Company in this Bill. The company, however, practically carried their scheme.

Dover.—The electric trams continue to be well patronised. During the week ended January 22nd, 25,890 passengers were carried, and a daily average of £17 19s. 7d. taken in fares. The total fares since the opening has been £2,265.

Electric Power Distribution Scheme.—Last Friday Mr. Devonshire (representing the British Thomson-Houston Company as chief engineer) addressed a number of manufacturers at the Swan Hotel, Mansfield, with respect to the proposed electric power scheme. He gave no quotations or terms for power at present, but could promise that it would be cheaper than steam.

Hastings.—Councillor J. J. Boutwood has been lecturing on "Electric Tramways" here, and his lecture was repeated at the Market Hall, on Wednesday, by request.

Hull.—We understand that, owing to the open specification, there was an enormous divergence in the tenders submitted for the electrical equipment of the Corporation tramways. The power quoted for varied from 466 kilowatts to 1,500 ditto; and the prices, of course, varied in a corresponding degree. Tenders were received from the following firms, viz., Mr. R. W. Blackwell; British Thomson-Houston Company, Limited; Brush Electrical Engineering Company, Limited; Crompton & Co., Limited; Electric Construction Company; John Fowler & Co. and Greenwood & Batley (joint); Laing, Wharton and Down; Lowdon Bros.; Mather & Platt; Thos. Parker, Limited; Siemens Bros. & Co., Limited; Simplex Electric Conduit Company; Westinghouse Electric Company, Limited. As we state elsewhere, Messrs. Siemens' tender has been provisionally accepted by the Works Committee, and their report was to come before the Council yesterday, Thursday, for confirmation.

Kirkcaldy.—The Ratepayers' Association is advising the Council to take up Prof. Kennedy's combined lighting and traction scheme, to which we referred last week. It is said that the present idea is to have 10 cars, five running in each direction.

Liverpool.—Sir Arthur Forwood, the chairman of the Tramways Committee, has prepared a report on the work of the tramways, with special reference to the question of low fares, and he recommends that for the electric tram system penny fares be adopted throughout the city, two-pence being charged for seats in the smoking compartment.

Middlesbrough.—The laying of the tramway rails in connection with the electric tramway from Thornaby to Middlesbrough has been completed, and the Highways Committee has voted £1,200 to the Imperial Tramways Company for wayleave.

New Cross and Waterloo.—We understand that this electric underground railway scheme is not to be proceeded with.

Newcastle-on-Tyne.—The City Council held its adjourned debate on the proposals in reference to the municipalisation of the tramways last week. The following resolution was passed:—"That in the next application to Parliament power be sought for the Corporation to work their own tramways; but that, until the scheme to be prepared by the recently appointed new Tramway Committee for providing the city with tramways has been considered by the Council, it is inexpedient to come to a determination as to whether the working of the tramways should be undertaken by the Corporation."

Ripon.—The Town Clerk is making inquiries as to the best means of providing a tramway—electric or cable—between Ripon Station and the market place.

The Power Distribution Schemes.—The Power Distribution Company has asked the Tipton Council to withdraw its opposition, on condition that the company agrees not to supply the electric light except with the Council's consent. A sub-committee will confer with the company and the other local authorities concerned.

The Ripley and Belper District Councils are among the latest bodies to oppose the scheme of the General Power Distributing Company.

The Darlaston General Purposes Committee recommends the Council to withdraw its opposition to the application of the Midland Electric Corporation for Power Distribution, subject to fair and reasonable conditions to secure economical terms to customers, and protective clauses in favour of the Council being inserted in the provisional order.

The "Underground" and Electric Traction.—In connection with the proposed employment of electric traction on the Metropolitan Underground, Mr. Bell, the chairman and managing director of the company made some important remarks to the shareholders last Friday:—"His anxiety had always been to see the Inner Circle worked first as an experiment by electricity. The departmental committee appointed by the Board of Trade to consider the ventilation question had arrived at certain conclusions, which were stated in the report. Although the committee had recommended various openings as a tentative measure, they had added a rider that if within three years from the passing of the Act authorising the openings, the company had not adopted electric traction, or other mechanical means of ventilation—which practically meant fans—some competent authority, to be stated by Parliament, should order the openings to be closed. That was if they were contumacious, which, however, no one could charge them with being. For the last 10 years the directors had had the idea of electric traction constantly before them. They all desired it, and they hoped they were on the high road to obtain it. Certain proposals were now under consideration, and he hoped that they would shortly be in such a condition that the directors could regard them as practicable. In that case they would immediately ask the shareholders for their approval. To enable them to be prepared for electric traction, Clauses 19 to 28 had been inserted in the Bill. The District Company were in accord with them in regard to electric traction. With respect to the question of ventilation by fans, they had tried fans, and he knew them to be a failure. He had expressed to the departmental committee his belief, after 25 years' experience of their railway, that electric traction was the solution of the problem they had been appointed to consider. The use of electric traction would involve entirely new stock."

Underground Electric for Brighton.—A Bill is to be introduced into Parliament next session, for power to form a company to construct an underground electric railway from a point near the station of the L. B. & S. C. Ry. Company, to a point under King's Road, but with openings under the parade communicating with the beach. The total length of the line will be 5 furlongs 17 25 chains. The capital of the company will be £120,000 with power to borrow £40,000 for equipment purposes. According to a financial daily, the maximum fare proposed to be charged is 2d. for the whole distance. The promoters names are Messrs. S. H. Doubleday, C. F. Webber, and J. W. Kersley.

Wallasey.—The District Council is about to take formally into consideration the desirability of taking over and working the local tramways, and also the question of employing electric power.

TELEGRAPH AND TELEPHONE NOTES.

Bedford Telephones.—A Committee is inquiring into the desirability of applying for a municipal telephone license.

Norwich Telephones.—At the Norwich Town Council last week there was a very lengthy discussion on the telephone system. Sir Harry Bullard, M.P., proposed that a petition be presented to the Postmaster-General to grant a municipal license, to be worked either by the Corporation or by a company approved by it; also that a deputation be appointed to present the said petition. The debate is to be continued at the next meeting.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cape Haitien-Puerto Plata	Dec. 31st, 1897 ...	Jan. 26th, 1898.
Curaçao-La Guayra ...	Jan. 5th, 1898 ...	...
Paramaribo-Cayenne ...	Jan. 27th, 1898 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	..
Para-Cameta	Jan. 13th, 1898 ...	Jan. 27th, 1898.
Saigon-Hong Kong	Jan. 8th, 1898 ...	...
Para-Maranham	Jan. 22nd, 1898 ...	...
Bolama-Bissao	Jan. 28th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Saigon-Bangkok	Jan. 22nd, 1898 ...	Jan. 24th, 1898.
Majunga-Tananarive	Jan. 26th, 1898 ...	Jan. 27th, 1898.
	Jan. 30th, 1898 ...	Jan. 31st, 1898.

The Direct West India Cable Company, Limited.—This company announces that its cables from Bermuda to Turks Island, and Turks Island to Jamaica, are now open for traffic, and that messages for these islands can now be sent at the rate of 3s. a word. The company draws attention to the fact that this is the only "direct" and all-British cable route to Jamaica and other West India islands (the other alternative routes being *viâ* the United States and Cuba, or the unsettled central American States).

CONTRACTS OPEN AND CLOSED.

OPEN.

Bilbao.—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Belgium.—February 11th. The Provincial Government Authorities in Brussels are inviting tenders for an installation of electric lighting in the offices of the Governor of Brabant in the Rue de Chêne, Brussels. Tenders to be sent to the Gouvernement Provincial, Brussels.

Belgium.—February 16th. Tenders are being invited by the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply of 38 electric tramcars. Tenders to be sent to, and particulars may be obtained from, the offices of the company, Rue de la Science, 26, Brussels.

Berlin.—March 15th. The Municipal Traffic Deputation of the Town Council have opened a competition for the construction of several new electric tramways in that city. Exhaustive details concerning this project are contained in the *Elektrotechnische Zeitschrift* of the 13th inst., which mentions that proposals will be received by the Stadtische Verkehrsdeputation Rathhaus III, Berlin, by March 15th.

Copenhagen.—March 12th. The Frederiksberg Sporveis-og Electricitets Aktieselskab want tenders for steam engines, dynamos, accumulators and switchboards. Offices of the company, Gl. Kongevei, 140, Copenhagen.

Denmark.—March 12th. Tenders are being invited for the supply of the engines, dynamos, accumulators, &c, required in connection with the new central station at Frederiksberg, near Copenhagen. Tenders to be sent to the Frederiksberg Sporveis-og Electricitets Aktieselskab, Gammel Kongerie, 140, Copenhagen V., from whom particulars may be obtained.

Edinburgh.—February 5th. The Corporation want tenders for the wiring of the Police Station, Abbeyhill. See our "Official Notices" January 28th for particulars.

France.—March 31st. Tenders are being invited by the Municipal Authorities of Saint Chamond (Loire) for the concession for the lighting of the public streets of the town, either by gas or electricity. Particulars from, and tenders to be sent to, La Mairie de Saint Chamond (Loire).

L.C.C.—February 16th. The London County Council Asylums Committee want tenders for a great variety of sundries. One of the items is for electric lighting sundries for Claybury. Particulars at the office of the Asylums Committee, 21, Whitehall Place, S.W.

Madrid.—February 22nd. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Chargé d'Affaires at Madrid, enclosing copy of a Royal decree announcing that a public auction for the contract for repairing the national submarine telegraph cables during the next five years will be held at Madrid on February 22nd. Further particulars as to the cables in question may be inspected at the Commercial Department of the Foreign Office any time between the hours of 11 and 5.

Redditch.—February 14th. The District Council want tenders for the supply of buildings, gas producing plant, gas engines, alternators, cables, transformers, &c, for the electric lighting of the district. Consulting electrical engineer, Mr. J. A. McMullen. See our "Official Notices" January 28th.

Rochdale.—February 19th. The Corporation want tenders for steam dynamos, balancer, and boosters, &c. Engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" January 14th.

Roumania.—March 15th. Tenders are being invited by the General Direction of the Roumanian Post and Telegraphs in Bucharest for the supply of 56,000 metres of galvanised iron and steel wire.

Spain.—February 11th. Tenders are being invited by the Municipal Authorities of Valderas (Leon province) for the concession for the electric lighting of the public streets of the town during a period of 17 years. Particulars may be obtained from, and tenders to be sent to, El Secretario del Ayuntamiento de Valderas (Leon).

St. Helens.—February 21st. The Corporation want tenders for various plant and machinery, &c., in connection with the proposed electric tramways. See our "Official Notices" January 28th for particulars. Consulting engineer, Dr. J. Hopkinson.

St. Pancras.—February 22nd. The Vestry want tenders for dry back marine boilers with superheaters and brickwork seatings. See our "Official Notices" this week.

The War Office.—April 27th. The Secretary of State for War is prepared to receive offers, competitive designs and specifications for the supply of portable electric search light apparatus. Particulars from the Director of Army Contracts, War Office, Pall Mall, S.W. See our "Official Notices" for particulars.

Victoria.—March 21st. The Telegraph Department of the Victorian Government Railways are inviting tenders for the supply of alternating current transformers and one main switchboard. Tenders to the Telegraph Superintendent's Office, Spencer Street, Melbourne.

CLOSED.

Bedford.—The Town Council has accepted the tender of Messrs. W. H. Allen, Son & Co., for the supply of a 420-B.H.P. double-acting compound engine for £1,375; also that of Messrs. Easton, Anderson & Goolden, for the supply of a 250-unit alternator for £1,075; that of Messrs. Rootham & Jeakings, for the erection of offices, store rooms, &c., near the electric light station, for £309. 100 electric lamp columns are to be obtained from Mr. W. Bradley, of Rastrick, for £250. A motor and flexible shafting for cleaning boiler tubes are to purchased at an estimated cost of £68.

Hull.—We understand that the Works Committee has given the contract for the electrical equipment of the tramways (including 20 cars) to Messrs. Siemens Bros. & Co. for £42,228.

Sheffield.—The Brush Electrical Engineering Company, Limited, has received an extension order from the Sheffield Electric Light and Power Company for a 600-kw. steam alternator for next winter's load, the plant to consist of an "Inductor" pattern alternator coupled direct to an "Universal" steam engine.

FORTHCOMING EVENTS.

1898.

Friday, February 4th, at 8 p.m.—The Institution of Junior Engineers, at the Westminster Palace Hotel. Paper on "Electro-Magnetic Brakes, and their Capabilities," by Mr. Louis H. Walter, A.I.E.E., of Cambridge.

At 12 noon.—Eastern Telegraph Company, extraordinary general meeting at Winchester House to confirm resolution approving the Company's Bill for capital conversion, &c.

Royal Institution. Mr. A. A. Campbell Swinton on "Some New Studies in Cathode and Röntgen Radiations."

Saturday, February 5th.—Institution of Electrical Engineers. Student's visit to the works of Messrs. Siemens & Co., Woolwich. Train from Fenchurch Street, 10.5 a.m. Applications to join the party, to the Student's Hon. Sec. (Mr. S. Grant, 28, St. Mary Abbot's Terrace, W.)

Monday, February 7th, at 7 30.—Society of Engineers' meeting at the Royal United Service Institution. Presentation of premiums by retiring president, Mr. G. M. Lawford. Presidential address, Mr. W. W. Beaumont.

Tuesday, February 8th.—Liverpool Overhead Railway Company. Meeting at Liverpool.

Ordinary and extraordinary general meetings of the St. James's and Pall Mall Electric Light Company.

Wednesday, February 9th, at 8 0 p.m.—The Institution of Electrical Engineers. "Notes on the Electro-chemical Treatment of Ores containing the Precious Metals," by Major-Gen. Webber, C.B., Past-President (conclusion of discussion). "An Electrolytic Process for the Manufacture of Parabolic Reflectors," by Sherard Cowper-Coles, Member.

At 12 o'clock.—City and Guilds Central Technical College, Exhibition Road. Second of a series of three lectures on "The Design and Testing of Power Cables for Specific Purposes," by Mr. Mervyn O'Gorman.

At 8 p.m.—Society of Arts. "Compensation to Workmen." By A. D. Provand, M.P.

Thursday, February 10th, and Friday, February 11th.—The annual general meeting of the Institution of Mechanical Engineers, at 25, Great George Street. The discussion on Mr. Philip Dawson's paper on "Mechanical Features of Electric Traction," will be resumed. A paper will be read and discussed as follows: "First Report to the Gas Engine Research Committee; Description of Apparatus and Methods, and Preliminary Results," by Prof. Frederic W. Burstall.

Friday, February 11th.—Physical Society (rooms of the Chemical Society, Burlington House). Annual General Meeting at 5 p.m.—Address by the President. After which at an Ordinary meeting: "On Electro-magnetic Induction in Plane, Cylindrical and Spherical Current Sheets, and its Representation by Moving Trails of Images," by G. H. Bryan, M.A., F.R.S.

NOTES.

Institution of Junior Engineers.—The 13th anniversary dinner of the members of this Institution was held at the Westminster Palace Hotel, Victoria Street, on Saturday night. Mr. J. A. F. Aspinall, M.Inst.C.E., the president, occupied the chair. Mr. Alexander Siemens proposed the toast of "British Railways," and Mr. R. Harrison, general manager L. & N. W. Ry., in response, congratulated Mr. Siemens and his fellow-workers on the Employers' Federation on the settlement of the engineers' dispute, which, he said, had been brought about after much labour and much anxiety. It was a settlement which, he thought, would be for the benefit not only of the employers—who did not even claim that it was a victory—but also of the workmen, and, not least of all, of the railway companies and those who had to transport the manufactured articles and the materials necessary for their manufacture. The chairman also responded. The toast of "A Realised Teaching University for London" was proposed by Dr. Perry, F.R.S., and Prof. Silvanus Thompson, F.R.S., in response, referred in eloquent and impassioned terms to the up-hill nature of the task in which the advocates of the reconstruction and enlargement of the University of London had been engaged. It was, he said, an extraordinary thing that in this great capital no opportunity should be offered for a student to take a degree in engineering. The apathy of London members of Parliament on the question was astonishing, seeing how great was the need for the reconstruction of the University. Mr. J. W. Swan, F.R.S., president of the Institution of Electrical Engineers, proposed the toast of the evening, "The Institution of Junior Engineers." He said the extension and greatness of the Empire were mainly due to the genius and enterprise of engineers, with whose future work the interests of the country were bound up. Mr. Vorley, who responded, mentioned that the Institution now comprised 500 members. Before resuming his seat he gave the toast of "The Honorary Members." Mr. Hiram S. Maxim, in reply, spoke of the advantages which electricity possessed over steam, and said it was to the former force that they must look if they wished to have more rapid transit and to double the speed attainable by the locomotive. The evening was

a thoroughly enjoyable one; indeed, Mr. W. T. Dunn, the popular and indefatigable secretary, invariably makes the Institution dinner a success in every way, but on this occasion the speeches were specially good, the music, for several years past a feature at these annual gatherings, was highly appreciated, and the cinematographic display of the Queen's Diamond Jubilee procession was admirably handled by the Messrs. Prestwich. We shall hope to see in each succeeding year large accessions to the ranks of the Junior Engineers, for to them we look for the men to carry on the work begun by those, who, one day, must leave the younger members of the profession to bring it to finality. The Junior Engineers may rest assured that nothing will be wanting on the part of the technical press to encourage them in all ways, and to give publicity to the doings of such an important body, youthful though it may be. What it lacks in experience, it makes up for in energy and determination to make its power felt, and we shall always take a pleasure in doing all that lies in our power to foster the further development of the Institution.

Obituary.—The death of Lord Sackville Arthur Cecil took place on Saturday afternoon at Holwood, Beckenham, Kent, the seat of his mother, Mary, Countess of Derby. His lordship had been ill for some eight weeks, but was making progress towards recovery until an attack of pleurisy supervened on pneumonia, which, in his weakened state, he was not able to fight against. He was a son of the second Marquis of Salisbury, and was born in 1848. Educated at Wellington College and Trinity College, Cambridge, he took his B.A. degree in 1869 and his M.A. in 1872. He had considerable scientific attainments, and became very well known in connection with both railways and telegraphs. In 1869 he acted as chief electrician on board the cable steamer *Africa* during the laying of the Marseilles Bona and Malta cable, and in 1870 served on the staff of the late Sir Charles Bright supervising the manufacture of telegraph cable for the Panama and South Pacific Company. Both these cables are to-day in working order between France and Algeria, the destination of the latter having been changed on account of a law suit and the subsequent liquidation of the Panama and South Pacific Company. From 1878 to 1880 he was assistant general manager of the Great Eastern Railway, and from 1880 to 1885 he was general manager of the Metropolitan District Railway. He also became chairman of the Exchange Telegraph Company and director of the Eastern Telegraph Company, the Brazilian Submarine Telegraph Company, the Globe Telegraph and Trust Company, and the Pacific and European Telegraph Company. He was a man of great activity, and was possessed of an enormous capacity for work. Lord Sackville Cecil's rectitude of character won the esteem of all those who were thrown into contact with him, and his loss will be severely felt by his numerous friends, and by the companies with which he was connected. The deceased was one of the original members of the Institution of Electrical Engineers.

On Thursday, the 27th ult., Major Alexander Wood was buried in the Parish Churchyard of Erith, in which district he had lived for some 25 years. The deceased was well known in telegraph circles, through his connection with the Western and Brazilian Telegraph Company, which he piloted through many storms. The loss of his keen perception and his master mind will be deeply felt by his colleagues. To those who served under him will his loss be great, as Major Wood's generous disposition made him continually think of the absent toilers whose work, in sometimes unhealthy climates, contributes so much to the well being of their chiefs and employers at home. While a generous man, the deceased was far from being a weak one, as he dealt severely with things and men when the occasion demanded this treatment. Major Wood was born at sea in 1843, and was the son of Captain Wood, one of the band of pioneer explorers in Central Asia. In early life he belonged to the Bombay Staff Corps, and saw active service in China and Japan. On his retirement from the Indian Army, in 1872, he began the work of his life, and in various capacities was connected with the projected Great Western Telegraph Company, with the Western and Brazilian Telegraph Company, the late Central American Telegraph Company, the Platino-Brazilian Company, and the Amazon Telegraph Company. Until within a year of his death, when his health failed him, he was the active head of the Western and Brazilian, the Platino, and the Amazon Companies. He was also director of the Pacific and European Telegraph Company. Many of our foreign readers may remember the cheery, active personality who attended the International Telegraph Conference of London, Berlin, and Paris. We join with many others in tendering our sympathy to his bereaved family.

We regret to record the death of Mr. C. W. Stronge, C.B., who succumbed to pneumonia at his residence in Whitehall Court on Sunday last. Mr. Stronge was born in 1816, the third son of the late Sir James Mathew Stronge, Bart., of Tynam Abbey, Armagh, and entered the Treasury in 1833. After a service of half a century in that Department, he retired from the post of principal clerk. He had at different periods of his career acted as private secretary to different Ministers, among these the Earl of Derby, during his Premiership. Mr. Stronge was made a Companion of the Bath on the recommendation of Lord Beaconsfield. He had served as official Government Director on the boards of subsidised telegraph and steamship companies, and at the time of his demise, was a director of the Eastern, and of the Eastern and South African Telegraph Companies.

Puzzle—Find the Trolley.—We sometimes get interesting news from across the Atlantic as to what is being done on this side. Occasionally the information is known there sooner than here, and we wonder why it has not been first divulged in England. For a quite new and interesting piece of information we go to the *American Machinist*, which says:—

> On a trolley line in Birmingham, England, the rails are made in Pittsburg, the cars in Philadelphia, the boilers in Erie, the engines in Milwaukee, and the electric fittings in Schenectady.

This paragraph bears a very rosy complexion to the American electrical manufacturers' eyes, which would be quite justifiable if only it were true. What we should like to know is, "How long has there been a trolley line at Birmingham?" This is the first we have heard of it.

Electric Automobiles in France.—The Société des Voitures Electriques, using the Krieger system, the large and well-known Parisian carriage works, which was established in 1895, will probably soon be known by the title of Compagnie des Automobiles Electriques, it being now, says the Paris correspondent of the *Electrical World*, on the point of changing its organisation, and making its capital 5,000,000 francs ($1,000,000). According to some comparative calculations of all the costs of installation and operation required by animal, oil-motor, and electric traction, this company states that all the advantages of economy lie with the electric system. For daily cost of operating cabs they give:—

For animal traction	...	15.44 francs	($3.10)
For a petroleum automobile	...	13.20 „	($2.65)
For an electric automobile	...	8.13 „	($1.63)

Dust Destructors and Electric Lighting. — The glowing accounts which are given from time to time about the success of the Shoreditch combined plant are having their effect, and municipal authorities in various parts are pursuing inquiries into the subject, in the belief that success is already assured. The Johannesburg Town Council has decided to go in for dust destructors, and the suggestion is now being made there to erect them at the electricity station at the lower end of President Street. In this connection, *Machinery*, a South African paper, urging steps to be taken in this direction, cites the Shoreditch plant as an "unqualified success from all points of view," and well worth imitating. As to the "unqualified success," we will, without referring again to the question of fuel, simply draw attention to some of the points raised on this very interesting subject, by Mr. Robert Hammond, in his remarks to the Gloucester Town Council last week. A brief report appears in another column.

Personal.—Mr. A. E. Worswick, chief electrical engineer of the Cape Town Tramways Company, has left Cape Town for Mexico, to take up a position in connection with the administration of a large electric traction system.

Forthcoming Lectures.—A special course of lectures on "The Design and Testing of Power Cables for Specific Purposes," have been arranged by the City and Guilds Institute to be delivered at the Central Technical College on Wednesdays at 12 o'clock, by Mr. Mervyn O'Gorman, late manager of the Fowler-Waring Cables Company. The first lecture was given on Wednesday, 2nd inst., and the others will take place on 9th and 16th inst.

Professorship Vacant.—Prof. Carey Foster resigns the Quain Professorship of Physics at the University College, London, at the close of the present session. Applications for the chair have to be made to the secretary, Mr. J. M. Horsburgh, M.A., by March 1st.

Our Volunteers.—A daily paper says that it is intended by the War Office to appoint non-commissioned officers of the Royal Engineers for the permanent staff of the new Corps of Electrical Engineer Volunteers, as soon as their services are required for training the Corps.

Toy Science.—This month's issue of *Good Words* has a very interesting illustrated article by Mr. James Swinburne on "Science of Some Toys."

Appointments Vacant.—The Birkenhead Corporation want a resident electrical engineer, at £300 per annum. See our "Official Notices."

The Northwich Electric Supply Company want a resident electrical engineer for their gas-driven electric light works. See our "Official Notices."

Municipal Electrical Association.—We hear that Mr. Alfred H. Gibbings, the city electrical engineer of Bradford, has been elected president of the Municipal Electrical Association, in succession to Mr. C. H. Wordingham, and will preside at the annual covention in London next June.

Lectures on "Electro-Deposition."—Prof. S. P. Thompson commenced on Wednesday at the Finsbury Technical College, a course of laboratory instruction and lectures on "Electro-Deposition." A syllabus of the course has been issued.

Falcon Works Engineering Society.—A very successful meeting of the Falcon Works Engineering Society was held at Loughborough, on Thursday last. Mr. R. P. Sellon presided, and a most interesting paper was read by Mr. J. J. Steinitz, the Borough electrical engineer for West Ham, on "Some Practical Hints on Starting a Municipal Electrical Department."

The American Blizzard.—The American blizzard has played havoc with the telegraph, telephone and trolley wires in Boston. The wires are down in all directions, and some of the accounts in the press say that over 200 horses lie dead in the streets through electrical shocks and extreme cold.

Lectures.—On the 22nd ult., Mr. A. H. Fison, D.Sc., commenced a series of ten lectures on "The Electric Current and its Modern Applications," at the Technical Institute, Wandsworth.

At the Bishopsgate Ward Club, last week, Mr. W. C. C. Hawtayne read a paper on "The Supply of the Electricity from Central Stations," and dealt with the question of municipal *v.* private enterprise. He referred to the error committed by the Commission of Sewers in giving over its electric lighting powers to two companies.

Mr. F. H. Headley read a paper on "Electricity, the Transmitter of Power," before the Mining Association and Institute of Cornwall, on Wednesday last week.

Mr. Wm. Lynd is delivering a series of lectures on "Wireless Telegraphy," in the Free Trade Hall, Manchester.

Presentation to Mr. H. C. Fischer, C.M.G.—It is stated that a movement is on foot among the superintendents and staff of the Central Telegraph Office, for the purpose of making farewell presentations to Mr. H. C. Fischer, C.M.G., who is, as already stated, about to relinquish the office of comptroller.

Personal.—Mr. Mervyn O'Gorman, late of the Fowler-Waring Cables Company, has joined Mr. E. H. Cozens-Hardy, chief assistant to the Brush Company's engineer, in an examination of Continental and American methods, with a view to a subsequent partnership in consulting work.

Telegraph Directors Dead.—The Pacific and European Telegraph Company has, within the last week, lost two members of the Board, in the persons of Lord Sackville Cecil and Major Alexander Wood. In addition to these two names a third has to be registered, Mr. C. W. Stronge, C.B., a director of the Eastern Telegraph Company, who has also died in the same week.

Telegraphists' Grievances.—The Postal Telegraph Clerks' Association have drawn up a circular letter which each postal employé will forward to the member for the constituency in which he lives, urging him to be present at the House of Commons on February 8th, when Mr. Sam Woods is to lay before Parliament the grievances of the service. The circular, says last night's *Pall Mall*, calls attention to the alleged inadequacy of pay and insufficient prospects, and points out that a man must complete 21 years of irreproachable service before he can receive 56s. per week. The association ask for a prospective £200 after 25 years of service, claim the absolute right of combination and free speech, and particularly call attention to the fact that absence through sickness for nine days may lead to compulsory retirement. They desire that this rule should be cancelled.

NEW COMPANIES REGISTERED.

Clench & Co., Limited (55,749).—Registered January 21st, with capital £80,000, in £10 shares, to acquire the business of "Clench & Co.," of Lincoln Works, Chesterfield, and elsewhere, to adopt an agreement with F. and G. M. Clench, and to carry on the business of mining, electrical, mechanical and general engineers, tool and implement makers, boiler makers, metal workers, &c. The subscribers (with one share each) are:—F. Clench, Lincoln Works, Chesterfield, engineer; G. M. Clench, Lincoln Works, Chesterfield, engineer; H. S. Johnstone, Springfield Road, St. Leonard's-on-Sea, solicitor; S. G. McDakin, 15, Esplanade, Dover, retired captain; E. Clements, 74, Southgate, Sleaford, engineer; E. W. Whattan, Rutland Road, Chesterfield, clerk; D. H. Davis, Longlands, Chesterfield, solicitor. The number of directors is not to be less than three, nor more than five; the first are the first five subscribers. Qualification, £500; remuneration as the company may decide. Registered by Devonshire & Co., 1, Frederick's Place, Old Jury, E.C.

Trehearne Electrical Engineering Company, Limited (55,798).—Registered January 26th with capital £2,000 in £1 shares, to carry on the business of electrical engineers, suppliers of electricity, electricians, electrical apparatus manufacturers, &c. The subscribers (with one share each) are:—S. G. Trehearne, 155, Fenchurch Street, E.C., electrician; J. A. England, 118, Abbeville Road, Clapham, stationer; A. J. Jackson, 66, Heaton Road, Peckham, gentleman; R. Bridge, Innellan, Cavendish Road, Sutton, printer; W. H. Hughes, 155, Fenchurch Street, E.C., clerk; F. C. Powell, 248, Haydon's Road, South Wimbledon, clerk; H. C. Clarke, Oakleigh, Merton Hall Road, Wimbledon, assistant. Table "A" mainly applies. Registered by S. G. Trehearne, 155, Fenchurch Street, E.C.

W. J. Jenkins & Co., Limited (55,826).—Registered January 27th, with capital £20,000 in £10 shares, to acquire the business carried on as "W. J. Jenkins & Co.," at the Beehive Works, East Retford, Notts., to adopt an agreement with W. J. Jenkins, and to carry on the business of gas, electrical and mechanical engineers, iron founders, millwrights, metal workers, contractors, &c. The subscribers (with one share each) are:—L. F. Trafford, 2, Sloane Street, S.W., major; Mrs. A. R. Trafford, 7, Sloane Street, S.W.; G. R. Trafford, Oxford and Cambridge Club, S.W., gentleman; J. Goodman, Yorkshire College, Leeds, professor; C. P. Smith, 41, St. Michael's Road, Northampton, traveller; J. W. Durnford, 24, Caledonian Road, East Retford, engineer; W. J. Jenkins, 125, Thrapston Road, East Retford, engineer. The number of directors is not to be less than three nor more than five; the first are:—L. F. Trafford, J. Goodman and W. J. Jenkins; qualification £1,000; remuneration as fixed by the company. W. J. Jenkins is the managing director with £400 per annum. Registered by Jordan & Sons, Limited, 120, Chancery Lane, W.C. Registered Office, Beehive Works, Retford, Notts.

Langdon Davies Electric Motor Company, Limited (55,830).—Registered January 27th, with capital £70,000 in £1 shares, to adopt an agreement with the Davies Motor Company, Limited, for the acquisition of certain agreements relative to alternate current motors, and to carry on the business of electricians, engineers, light and power contractors, and electrical manufacturers. The subscribers (with one share each) are:—E. W. S. Crawley, 44, Castletown Road, West Kensington, engineer; C. E. Cree, 12, Nevern Road, Earl's Court, barrister; A. W. Cree, Brodsworth, Beckenham,

solicitor; H. E. Cree, Benenden, Eastbourne, solicitor; W. S. Matingly, 113, Highbury Hill, N., clerk; W. L. Davies, 61, Gwendwr Road, West Kensington, engineer; A. Soames, Walpole Lodge, Bromley, Kent, engineer. The number of directors is not to be less than three nor more than nine. The first are C. E. Cree, A. W. Cree, W. Langdon Davies, A. Soames, and E. W. S. Crawley. Qualification £1,000; remuneration not more than either 10 per cent. of the profits, or a £1,000 per annum dividend. Registered by Cree & Son, 13, Gray's Inn Square, W.C.

United Ordnance and Engineering Company, Limited (55,860).—Registered January 29th with capital £550,000, in £1 shares (275,000 £5½ per cent. cumulative preference), to acquire and turn to account the benefit of a contract with Schneider & Co., of Creuzot, for the manufacture of the Schneider-Canet Artillery, in the United Kingdom and its colonies, to acquire and carry on the business of mechanical, hydraulic, electrical and mining engineers, carried on by Easton, Anderson & Goolden, Limited (registered in 1894), and to adopt an agreement with E. T. Hooley. The subscribers (with one share each) are:—H. F. Nicholson, Cobham, Kent, admiral; C. Cammell, Sheffield, gentleman; H. K. Baynes, 15, Chapel Street, S.W., gentleman; W. T. Marriott, 56, Ennismore Gardens, S.W., Queen's councillor; E. Legge, 7, Albion Street, W., barrister; P. B. Dobson, Zulla Road, Nottingham, gentleman: H. P. King, 36, Savernake Road, South Hampstead, clerk. The number of directors is not to be less than five nor more than eleven; the first are—H. F. Nicholson, K.C.B., F. Elgar, H. McCalmont, E. Cammell, P. Mosley, T. Wilson, and H. K. Baynes. Qualification £1,000; remuneration £300 each per annum (£500 for the chairman), together with £1,000 per annum, divisible, for every 1 per cent. in the ordinary dividend above 5 per cent. Registered by Golding & Hargrove, 93, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Railways' Electric Supply Syndicate, Limited (52,812).—This company's statutory return was filed on November 13th, when 7,000 shares were taken up and issued as paid, out of a capital of £10,000 in £1 shares.

Silicon Electric Lamp Syndicate, Limited (47,238).—This company will not be proceeded with, as the patents, for the acquisition of which the undertaking was formed, have been otherwise disposed of and the name of the company will be struck off the register.

Rand Central Electric Works, Limited (43,712).—This company's annual return was filed on January 7th, when the capital of £300,000 in £1 shares was taken up in full. 25,000 shares are considered as paid, and £275,000 has been received.

Single-Wire Multiple Telephone Signal Company, Limited (16,875).—This company's annual return was filed on December 24th, when 374 shares were taken up and paid for in full, out of a capital of £5,000 in £10 shares.

CITY NOTES.

The St. James' and Pall Mall Electric Light Company, Limited.

THE ordinary general meeting will be held at Carnaby Street Central Station, Golden Square, W., on Tuesday, February 8th, at 12 o'clock, and the directors' report to be then presented reads as follows:—"The directors submit their report for 1897, with the accounts as certified by the company's auditors. The extension of Carnaby Street Station is on the point of completion, and will soon be equipped with a full plant of 5,000 horse-power. It has been working satisfactorily throughout the year in connection with the station at Mason's Yard. Steady progress has been made in the increase of the company's supply to private consumers, and the principal streets of the district are now lighted by electricity. An agreement, dated December 16th, 1897, has been made with the holders of founders' shares by which, subject to confirmation by the shareholders, they will receive an allotment of 120 ordinary shares at par in exchange for each founders' share, such exchange to take effect as and from January 1st, 1898. In order to carry out this agreement steps are being taken to increase the capital of the company to £300,000 by the creation of 20,000 new ordinary shares of £5 each, of which 12,000 £5 shares are to be issued at par to the holders of the founders' shares. This will give the company £60,000 additional capital at once, and will, in effect, extinguish the founders' shares. The net earnings of the company during the past year have amounted to £29,093 17s. 7d. Of this sum, £6,996 10s. was distributed in August last in payment of an interim dividend at the rate of 7 per cent. per annum for the half-year ending June 30th, 1897, on the ordinary shares, and of 7 per cent. per annum on the preference shares. The balance, £22,097 7s. 7d., together with the undivided profit of £327 15s. 9d. from last year's account, leaves £22,425 3s. 4d. now to be dealt with.

"The directors propose to divide the amount as follows:—

	£	s.	d.
(*a*) By payment of a dividend at the rate of 7 per cent. per annum on the preference shares for the second half of the year	3,500	0	0
(*b*) By payment of a dividend on the ordinary shares for the second half-year of 11s. per share, making, with the interim dividend paid on August 2nd last, a total distribution of 14½ per cent. for the year	10,989	0	0
(*c*) By payment of a dividend of £75 10s. 4d. per share on the founders' shares...	7,551	13	4
(*d*) Amount to be carried forward to ordinary shareholders' undivided profit account ...	384	10	0
	£22,425	3	4

"Sir John H. Morris, K.C.S.I., and Mr. Bennett Fitch, M.Inst.C.E., are the directors who retire by rotation under clause 79 of the articles of association, and, being eligible, offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and, being eligible, offer themselves for re-election."

At the conclusion of the annual ordinary meeting of the company, an extraordinary general meeting will be held for the purpose of confirming the following resolutions passed at the extraordinary general meeting of the company, held on January 18th, 1898, so as to make them special resolutions:—

"1. That the agreement bearing date December 16th, 1897, and made between the company of the first part, the parties whose names are subscribed in the first column of the schedule thereto, being the registered holders of the 100 founders' shares of £1 each in the company of the second part, and Eustace James Anthony Balfour and Josiah Latimer Clark of the third part, be, and the same is hereby approved, and that the directors be, and they are hereby authorised to carry the same into effect.

"2. That the capital of the company be increased to £300,000 by the creation of 20,000 new ordinary shares of £5 each, and that notwithstanding the provisions of article 4 of the articles of association, 12,000 of such 20,000 new ordinary shares of £5 each be issued at par to the registered holders of the 100 founders' shares of £1 each in the company as provided by the said agreement, December 16th, 1897.

"3. That the directors be and they are hereby authorised to issue to any registered holder of a founders' share at any time hereafter, not more than 120 new ordinary shares of £5 each at par upon such founders' shareholder transferring each founders' share, of which he is the registered holder to Eustace James Anthony Balfour and Josiah Latimer Clark as trustees for the company, nothwithstanding that the said agreement of December 16th, 1897, may not have been executed by the holders of the whole of the said 100 founders' shares within the three months provided by Clause 5 thereof."

City and South London Railway Company.

THE ordinary general meeting was held last Friday at Winchester House, Mr. Charles G. Mott presiding. In moving the adoption of the report, the chairman regretted that they were not able to recommend an increase in the dividend on that occasion over what they paid for the corresponding period of the previous year. In the December half of 1896 they had what was for them a very large increase in their traffic owing to two very important matches of the Australian cricketers at the Oval, and, moreover, that half-year was favourable for them, the weather having been severe as compared with the mild and dry autumn or early winter they had had this year. It was, he thought, very satisfactory that they were able to show, in the circumstances, an increase in their receipts from passengers and parcels of about £40. He thought it clear that a natural increase was going on in their traffic, apart from what they might derive from exceptional causes. Their line at present had no connections with any other railways, nor did it run through a district which was a very busy one. The extensions were going on very satisfactorily, and considerable progress had been made at Finsbury Pavement. Both tunnels were very nearly completed along Moorgate Street to the Bank. It would take some weeks before one of these tunnels was quite finished up to the Bank, and they would then only have to tunnel a very little further up to the station in Lombard Street. The tunnel on the south side of the river, starting at Denman Street for the London Bridge Station, and going in a southerly direction, was very nearly completed, and would in a few weeks be up to the junction with the old line, where the new line left the existing line. One of the tunnels from that station northwards towards the City was completed to the extent of about one-third under the river. The necessity which they were under of upholding the church of St. Mary Woolnoth, at the corner of Lombard Street, which had given them a great deal of trouble in the past, would probably cause them some delay. In view of this fact and the necessity which had been thrown upon them of upholding the church, they were asking Parliament in a Bill they were promoting this Session to empower them, if there was any consequent delay in completing the line within the time expected, and they therefore had to incur expenditure in dividend on the preference shares they had issued, to charge such dividend in the first instance to capital account. As they were aware, they issued for these extensions £200,000 of preference shares, the dividend on which was deferred, and was not to begin to accrue until January 1st next. The first half-yearly dividend on these shares would not become payable until August, 1899, and he might state that the reserves they now had in

hand were equal to one-half of the dividend which they would then have to pay. They had been acquiring property for the station for the Clapham extension, as they thought it very desirable that that line should, if possible, be completed by the time that the other extensions were finished and opened. Most of the property necessary for the two stations in connection with that extension had been acquired. They were negotiating for letting the contract for this extension, in connection with which they were, of course, providing for increased power, &c., at the generating station. The contract time for completing this extension would expire on September 30th next, and they had good hopes for believing that a year hence they might be able to announce that that line was ready for opening. Having referred to the City and Brixton Railway, and to the negotiations which had gone on with certain parties who were willing to construct this line, he stated that their company would work it from their central generating station. They would hold a Wharncliffe meeting on the 17th prox., when they would submit that company's Bill and also their own Bill, when full details would be given and the provisional arrangement with the City and Brixton Company would be set forth. With a view to an interchange of traffic they had entered into an arrangement with the Central London Railway Company, whose line commenced at the Mansion House and went by way of Holborn and Oxford Street to Shepherd's Bush. That company, he believed, would have a very important traffic, and it had been arranged that the platforms of their stations at the Bank and their station below should be connected by a short subway. They believed there would be a very large interchange of traffic in consequence of this arrangement, which would prove of great convenience to a vast number of people. Their Finsbury Pavement station was exactly opposite the booking office of the Moorgate Street station, and there should be a considerable interchange of traffic between the two lines. They would also have an interchange of traffic at London Bridge with the South-Eastern and Brighton companies. When, too, the Clapham extension was completed, they would have a station very near the Clapham Road station of the Chatham and Dover Company, and there also there would be a means of interchange of traffic. In addition, powers had already been obtained for two other lines, which were going to Finsbury Pavement—he referred to the Great Northern and City Railway, which would go from Finsbury Park to Finsbury Pavement, and the Epping Forest and Walthamstow line, the terminus of which would be very close to Finsbury Pavement station. Traffic would be brought to their undertaking by these lines from all parts of London, and an immense interchange of traffic might be looked for with these different railways. They had deposited a Bill for extending the time for constructing that part of the line which it was not at present proposed to build—namely, from Finsbury Pavement to the Angel at Islington.

Mr. Sampson Hanbury seconded the motion, which was adopted.

Buenos Ayres and Belgrano Tramways Company.

An extraordinary general meeting of this company was held on Tuesday, at Winchester House, for the purpose of considering a draft agreement with the Buenos Ayres and Belgrano Electric Tramways Company, Limited, for amalgamation with the latter.

Mr. John Morris, who presided, said the proposed new company would have a larger mileage of lines than the present one, and for horse traction it was intended to substitute electricity. The advantages of electric traction had long been before the public in other countries to a greater extent than in England. In the United States it had almost everywhere superseded animal power, and on the Continent of Europe, especially in Germany, it was well known and highly appreciated both on account of its convenience and economy. With electric traction it was possible to estimate accurately the cost of running cars, as it made companies independent of good or bad harvests, and other temporary causes of that kind. The cost of traction was practically reduced by one-half. He quoted the experiences of Montreal and Hamburg, in both of which the old tramways had fallen upon evil days, but had been resuscitated and made prosperous by the adoption of electricity.

The proposal was carried.

Official Announcements re Companies.

The Registrar of Joint Stock Companies gives notice in the *London Gazette* that the following and many other companies will be struck off the register within three months, unless cause is shown to the contrary:—

Birmingham House-to-House Electricity Company, Limited.
Caustic Soda and Chlorine Syndicate.
Dalziel's Atlantic Telegram Company.
Electrical Accessories Company.
Electric Light and Power Share Trust.
Exeter Electric Light Company.
Irish House-to-House Electricity Company.
Lancashire and Cheshire House-to-House Electricity Company.
Liverpool House-to-House Electricity Company.
Manchester House-to-House Electricity Company.
Midland House-to-House Electricity Company.
Nightingale Automatic Electrical Machine Company.
Northern House-to-House Electricity Company.
Pacific Telegraph Company.
Railway Electric Fog Signal Syndicate.
Railway Electric Reading Lamp Company.
South of England House-to-House Electricity Company.
Western House-to-House Electricity Company.
Wrexham and District Electric Supply Company.

Metropolitan Electric Supply Company.

The following letter from a holder of founders' shares in this company appears in the *Financial News*:—"The proposal of the directors of the Metropolitan Electric Supply Company to offer in exchange for each founders' share an allotment of 140 ordinary shares at par, strikes me (a holder of two of the founders' shares) as a very inadequate proposal considering the present rapidly-increasing revenue of the company. It must be remembered that there are only 100 founders' shares in this company, and that the holders thereof are entitled to one-half of the entire profits after 7 per cent. is paid on the ordinary; this will ultimately mean a very large sum indeed as the capital increases. I venture to think, therefore, that the holders of founders' shares will do well to decline the directors' proposal at the forthcoming meeting.—C. Temple Layton."

Anglo-American Telegraph Company, Limited.

The report of the directors to the ordinary general meeting of the proprietors, to be held at Winchester House to-day, at 2 o'clock p.m., states that the total receipts from July 1st to December 31st, 1897, including the balance of £8,507 5s. 11d. brought forward from the last account, amounted to £187,832 0s. 11d. The traffic receipts show an increase of £6,540 as compared with the half-year ended December 31st, 1896. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £58,372 4s. 5d., being an increase of £371 16s. 8d. over the corresponding period of 1896. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £117,459 16s. 6d. Interim quarterly dividends of 14s. per cent. on the ordinary stock, and £1 8s. per cent. on the preferred stock, were paid on November 1st last, absorbing £49,000, leaving a balance of £68,459 16s. 6d., out of which the directors recommend the proprietors to declare final dividends of 19s. 6d. per cent. on the ordinary stock, and £1 19s. per cent. on the preferred stock, amounting to £68,250, thus making a total distribution for the year ended December 31st, 1897, of £3 per cent. on the ordinary stock, and £6 per cent. on the preferred stock. The balance of £209 16s. 6d. will be carried forward to the next account. The cables and land lines of the company are in good working order. In accordance with the articles of association, two directors of the company, Sir Gerald FitzGerald and Charles Burt, Esq., retire at this meeting, and, being eligible, offer themselves for re-election. Mr. Joshua Dean and Mr. John Gane, F.C.A., the auditors, retire, and offer themselves for re-election.

Central London Railway Company.

The fifth ordinary general meeting was held on Wednesday at 16, Great George Street, S.W., Mr. Henry Tennant presiding.

The Chairman remarked that the number of shareholders had slightly increased during the half-year, and the number now stood at 1,073. In moving the adoption of the report, he said: On reference to the report you will perceive that the expenditure up to the end of the half-year now under review, has been £1,606,948 7s., and that the amount received on shares is £1,407,042. The expenditure, therefore, appears to have been more than the receipts, and the capital account shows a debit balance of £199,906 7s. Now this, in the main, is explained by the fact that £228,000 odd appears as owing to the Electric Traction Company under certificates from the engineers—that is, the engineers have certified that this sum is due to the contractors, and the company have not paid them. If you will look at the accounts, you will see that the Traction Company covenanted to take up a certain number of shares, and they now stand in the accounts as unissued shares. This, the Traction Company are ready to do, and therefore the sum entered as payable to them will be disposed of on the transactions as to the shares being completed, and that will be so completed before very long. The share capital, when that has been done, will stand thus:—The whole of the share capital will stand as issued with no less than £6 per share paid up thereon. I think there is nothing else in the accounts which I need trouble you about at present. What is more important is the question of the progress of the works which is dealt with in the engineers' report. According to that report, good progress has been made during the past six months, and I am glad to say that no serious hindrance to the engineers' operations have occurred during the half-year. You will observe the interesting fact that three-fourths of the ordinary tunnel—that is the main line tunnel, has been completed as well as one-half of the station tunnels—these station tunnels are, of course, a good deal wider than the ordinary tunnels so as to make room for platforms. One-half of these have been completed, and the shafts for the lifts, and staircases, the engineers say in their report, have been constructed. Of course, there may be some finishing work, but the main operation has been completed. I think I have said before that a very difficult work had to be undertaken, viz, the diversion of sewers. They are very difficult things to touch, especially in London, I think, and then gas and water pipes had to be taken up or removed, and all that had to be done under the pavement at the Bank Station. Now, this is proceeding satisfactorily, and part of it is practically complete, and the public subways are well advanced. The operations in connection with access from the Waterloo and City Company to the public subways at the Bank are also, according to the engineers, making satisfactory progress, although great difficulty was encountered in the construction of this part of the work owing to sewers and other obstructions which had to be dealt with. I hope that all these difficulties are now practically surmounted. We have agreed provisionally for the construction of a low level connection between the platforms of the City and

South London Railway and the platforms of the Central London at the Bank station. The terms are to be embodied in an agreement, which the South London Company are preparing, and as we have not yet received it, I am not in a position to say anything further at the present moment respecting it. The arrangements for the supply of electrical equipment have been made, and the works have been commenced. In the present position of the railway, there are no materials for any long speeches. The time will come when the occupant of the chair, whoever he may be, will have plenty to talk about—that is, when the line has been completed for traffic, and is earning a dividend. He moved the adoption of the report, and the payment of interest at the rate of 3 per cent. per annum on the paid-up capital of the company.

Lord COLVILLE OF CULROSS seconded the motion, which was agreed to.

Mr. Tennant was re-elected a director.

The Liverpool Overhead Railway Company.

THE directors' report to be presented to the half-yearly meeting of the shareholders, to be held at the Law Association Rooms, 14, Cook Street, Liverpool, on Tuesday, 8th inst., reads as follows:—

"In presenting the half-yearly statement of capital and revenue accounts to December 31st, 1897, the directors have to report that the gross revenue receipts amount to £37,583, and the working expenses to £24,240 4s. 1d.

"The number of passengers carried during the last two years is as follows:—

	Half-year ending June 30th, 1896.	Half-year ending December 31st, 1896.	Half-year ending June 30th, 1897.	Half-year ending December 31st, 1897.
First class ...	455,561	476,817	608,278	621,392
Second class ...	2,284,823	2,473,828	2,618,844	2,790,768
Workmen (special return tickets) ...	999,191	968,489	1,042,138	1,055,330
Total ...	3,739,575	3,919,134	4,269,260	4,467,490

REVENUE ACCOUNT.

Receipts from passenger traffic amount to ...	£36,994	12 0
Miscellaneous receipts and interest	588	8 0
	£37,583	0 0
Less working expenses	24,240	4 1
	£13,342	15 11
Deduct interest on mortgage debentures ...	3,400	0 0
	£9,942	15 11
Add balance brought forward, June 30th, 1897	3,810	6 0
Leaving available for dividend	£13,753	1 11

"Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after February 11th next:—

5 per cent. per annum on preference shares ... £3,000
3½ „ „ ordinary shares ... 7,875

leaving a balance of £2,878 1s. 11d. to be carried forward to next half-year.

"The directors retiring by rotation at this meeting are Mr. Edward Lawrence and Mr. George Hunter Robertson, who, being eligible, offer themselves for re-election. The auditor retiring by rotation is Mr. George Nicholson, who is also eligible for re-election."

The Yorkshire House-to-House Electricity Company, Limited.

THE annual general meeting of the shareholders of the Yorkshire House-to-House Electricity Company, Limited, was held on Tuesday afternoon at the Great Northern Hotel, Leeds, Mr. Grosvenor Talbot presiding.

The CHAIRMAN, in moving the adoption of the balance-sheet and report, said that he hoped it would prove satisfactory to all. The amount of capital now raised by shares was £131,932, an increase of £33,372 over last year. The total amount expended on capital account was £161,009, representing an increase of £55,632. The large additional expenditure had been due in the first place to the erection of new buildings. They had added 1,000 horse-power to their engine capacity, the total capacity being now 2,800 horse-power, and had also largely improved the means of supplying the current to the centre of the town. They proposed to pay the same dividend as last year, and for this half-year at the rate of 7 per cent., making 6 per cent. for the year. The depreciation fund now amounted to £6,660, and the reserve fund to £8,000, while the total amount they held in reserve in one form and another was £17,929. During the past year they had increased the number of lamps by 9,754, and the units sold by 131,871. The Chairman then referred to the recent reduction of price, which, he said, had made electricity in Leeds the cheapest illuminant, and then went on to deal with the proposed acquisition of the company by the Corporation. In connection with this matter, he said that the directors knew no more about the subject than the shareholders themselves. He felt sure that they would endeavour to meet the demand in a fair spirit. The Corporation were sending a deputation to meet the directors in a week's time. The company was a flourishing and progressive concern, and he was confident that whatever they would be able to get from the Corporation would not be anything like its value either in the property or the rights which the Corporation would gain and which they would have to surrender.

Mr. A. G. LUPTON seconded the resolution, which was carried unanimously.

A number of questions were asked as to the suggested taking over by the Corporation. Mr. Colbeck said that he had heard that some of the founders' shares might come into the market in order that their position might be tested.

The CHAIRMAN said that he had not heard of there being any likelihood of anything of the sort taking place. He did not think that anyone really knew what the value of those shares was, though a gentleman had written from London offering £170 each for them. Not a single share of that class had ever changed hands.

In answer to a question as to whether an effort had ever been made to redeem the founders' shares, the chairman said that the directors had inquired into the matter, and discovered that they could not redeem the shares without putting such a burden upon the concern as to render it extremely improbable that the shareholders would consent to the scheme. It would be such an exhaustive process that it would do away with dividends for some time to come.

Mr. A. G. Lupton and Mr. J. T. Pearson were re-elected directors, and the meeting closed with a vote of thanks to the chairman.

National Telephone Company.—The directors last week resolved, subject to final audit, to recommend, at the forthcoming general meeting of shareholders, the following dividends for the half-year ending December 31st, last: At the rate of 6 per cent. per annum, less income-tax, on the amounts paid up on the first and second preference shares; at the rate of 5 per cent. per annum, less income-tax, on the amounts paid up on the third preference shares; at the rate of 6 per cent. per annum, free of income-tax, on the amounts paid up on the ordinary shares, carrying £40,000 to reserve, and about £9,000 forward. The transfer books will be closed from February 4th to the 17th, both days inclusive, and the dividend warrants will be posted on the latter date. With regard to the 130,766 third preference shares issued in June last, the dividends thereon will be calculated from the dates fixed for payment of the various instalments.

Stock Exchange Notices.—The Stock Exchange Committee has appointed Wednesday, February 9th, a special settling day in New General Traction Company, Limited—20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 34,001 to 54,000; and has ordered the undermentioned securities to be quoted in the Official List: City and South London Company—further issue of 832 5 per cent. perpetual preference shares, Nos. 8,420 to 9,251; New General Traction Company, Limited—20,000 6 per cent. cumulative preference shares, Nos. 34,001 to 54,000.

General Electrolytic Parent Company.—The directors of the General Electrolytic Parent Company, Farnworth, near Widnes (owners of the Hargreaves-Bird Electrolytic Alkali process), have issued warrants to the shareholders for the payment of an interim dividend of 50 per cent. on the capital of the company, free of income-tax.

Waterloo and City Railway Company.—The report of the directors and statement of accounts for the half-year ended December 31st, 1897, states that the sum of £113,170 was expended during the half-year. The shares being now fully paid up, the directors recommend that they be converted into a general capital stock.

Cuba Submarine Telegraph Company.—The directors have declared a dividend for the past half-year at the rate of 6 per cent. per annum.

The Electric Light Company.—A private meeting of the above (a new company) was held on Monday last, at Cannon Street Hotel.

London Electrical Cab Company.—The letters of allotment for the new issue of shares, have been posted.

TRAFFIC RECEIPTS

The City and South London Railway Company. The receipts for the week ending January 30th, 1898, were £1,059; week ending January 31st, 1897, £1,101; decrease £42; total receipts for half-year, 1898, £5,393; corresponding period, 1897, £5,488; decrease, £95.

The Liverpool Overhead Railway Company. The receipts for the week ending January 30th, 1898, amounted to £1,337; corresponding week last year, £1,227; increase, £110.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 28th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,808.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Jan. 26th.	Closing Quotation, Feb. 2nd.	Business done during week ended Feb. 2nd, 1898. Highest.	Lowest
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 —104	100 104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5% Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	3 %	61 — 63	62 — 64	62½	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	6 %	111 —112	112½ - 113½	113	111⅝
3,038,020£	Do. do. Defd.	Stock	...	...	...	12⅝ - 13½	13½ - 13⅝	13⅜	12⅛
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	...	...	16½ - 17	16⅝ - 17⅛	...	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	187 —192	187 —192	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	106 —108	107½	106⅝
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	1/16 — 1/16	1/16 — 1/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	8 — 9	8 — 9	8¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	18 — 19	18 — 19	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	4½%	4½%	...	103 —106%	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10½— 11	10½— 11	11	10½
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	18 — 18½	18 — 18½	18⅛	18⅛
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	19 — 20	19 — 20	19½	...
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5%	...	102 —105	100 —103 xd	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	131 —124	131 —134	133½	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7½	...	18⅜ - 19¼	18⅜ — 19¼	19¼	18⅞
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5%	...	99 —103	99 —103	...	...
100,500£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5%	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4%	...	132 —135	130 —133 xd	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5%	...	99 —103	99 —103	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4%	...	104 —107	102 —105 xd	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	108 —111%	108 —111%	108	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	12 — 12½	12 — 12½xd	12 1/16	12
180,042	Do. do. 6 % Pref.	10	6 %	6%	...	17⅜ - 18½	17⅜ — 18½xd	18 1/16	17⅞
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	...	27 — 28	27 — 28	...	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	...	101 —104	101 —104	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	...	52 — 55	52 — 55	54¼	54½
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6%	...	108 - 111	108 —111	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	...	...	2 — 2⅛	2 — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5½%	5½%	6 %	6⅜ - 6⅞	6⅜ — 7	7	6½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	16 1/16	16½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	16	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6 7/16	6⅜
130,766	Do. do. Nos. 119,235 to 250,000, £5 paid	5	...	...	5 %	6 — 6½	6 — 6½	...	...
329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —109	104 —109	106½	104½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝ - ¾	⅝ - ¾	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	105 - 108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	7½ - 8½	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	140 — 145	140 — 145	...	...
58,000	United River Plate Teleph., Ltd.	5	4 %	...	...	4 — 4½	4 — 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	101 —106	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	nil	...	4 — 5	4 — 5	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 —106	...	...
64,268	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	...	9⅜ - 10¼	10½ - 11	10 1/16	10⅜
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	...	7½ — 8	7½— 8	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	...	...	2⅝ — 3¼	3½ — 4	3⅝	3¼
382,230	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —107	105 —107	106½	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	1 %	...	⅜ — ½	½ — ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	7 — 7½	7⅝ — 8¼	8	7½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600 ...	100	5 %	5 %	...	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7%	...	105 —110	105 —110	...	...
160,100£	Do. do. 6 % Ster. Bonds.	100	6 %	6%	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	7 %	14 — 15	14 — 15	15	14⅜
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6½ - 6⅝	6½— 6⅝	6⅝	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	...	10⅜— 11⅛	11⅛— 11⅜	11⅜	11
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	4½%	4½%	...	112 —114	112 —114	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	7 %	...	30 — 31	29½ — 30½	31	29½
10,000	Do. do. Prov. Certs.	5	...	...	...	29½— 30½	29 — 30	29½	28½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	17 — 18	17½— 18½	17⅞	17⅝
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	129 —134	129 —134	131	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	nil	nil	...	15 — 15½	15⅜— 16⅛	16⅛	15½
20,000	Do. do. do. 6% Pref., 40,001—60,000 ...	10	6 %	6 %	...	15⅜— 16⅛	15⅜— 16⅛	16⅛	15 1/16
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	10 — 11	10½— 11½	11	10⅝
10,000	Do. do. 7 % Cum. Pref. ...	5	...	...	...	11½— 11⅝	11½— 12	12	11 3/16
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	4 %	5 %	...	19½— 20½	20 — 21	20⅝	19⅞
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem. ...	10	...	...	...	19 — 20	19½— 20½	19⅞	19 5/16
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 — 121	117 —121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2:%	4 %	...	18 — 19	18 — 19	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	10½%	14½%	18 — 19	18 — 19	18⅞	18⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	4 %	101 —104	101 —104	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	3 1/16	2⅞
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	17 — 18	18 — 19	18⅝	18

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred shares warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation. Jan. 26th.	Closing Quotation Feb. 2nd.	Business done during week ended Feb. 2nd, 1898. Highest	Lowest.
30,000	British Electric Traction	10	...	...	...	17¼ — 17⅜	18½ — 19	18⅞	17½
90,000	Brush Elect. Engng. Co., Ord., 1 to 90,000... ..	£	.	...	...	2⅛ — 2⅜	2⅛ — 2⅜	2 7/16	2 3/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 9 ,000	2	..	...	...	2⅜ — 2⅝	2⅜ — 2⅝	2⅝	2 5/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ..	Stock	...	...	...	109 — 113	109 113	...	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ..	Stock	...	...	...	.02 —105	102 —105	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10¼	9⅜ — 10¼	10 3/16	10
143,106	Do. do. do. £6 paid	10	...	...	...	5⅝ — 6¼	5⅝ — 6¼	6 3/16	5 15/16
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1¼ — 1⅜	1¼ — 1⅜	1⅜	1 7/16
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	4 9/16	4¼
630,000*l*	City and South London Railway	Stock	1 1/16 %	1 1/16 %	1 1/16 %	69 — 71	69 — 71	71	70½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	...	...	2¼ — 2⅜	2¼ — 2⅜	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5 1/16 %	...	2½ — 3	2½ — 3	2 3/16	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 1/16 %	...	4½ — 5½	4½ — 5½	4 3/16	4⅜
110,000	Electric Construction, Ltd., 1 to 110,000	2	5 %	6 %	...	2⅜ — 3	2⅜ — 3xd	2 5/16	2 3/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	3⅜	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	...	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	...	...	...	⅜ — ⅝	½ — ¾	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	.	...	9 — 11	9 — 11	..	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	8 %	10 %	...	21 — 22	21½ - 22½	22	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	18½ - 19½	19 — 20	19⅜	..
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	...	110 —115	110 - 115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	...	23 — 24	22½ - 23¼	23¼	22⅝
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	..	...	...	103 —107	103 —107	...	..
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	...	11⅜ 11½	11 5/16 - 11 7/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	16 — 16½	16 — 16½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	15 %	...	39 — 42	39 — 42	40½	39⅝
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	1 2 —105	102 —105	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000	10	...	.	...	12⅜ — 13¼	13½ — 14	13⅞	13

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0 9/16; 1891—7 3/16; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.

Electric Construction Corporation, 6 % Debentures, 105—106.

House-to-House Company, 4½% Debentures of £100, 108 —110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 15—15½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 3—3¼.

* T. Parker, Ltd., £10 (fully paid), 12⅜.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8¼—8⅜. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

THE INSTITUTION OF ELECTRICAL ENGINEERS.

ABSTRACT OF INAUGURAL ADDRESS.

By J. W. Swan, F.R.S., President.

(*Concluded from page* 132.)

Gold Extraction.

Before the introduction of the cyanide process for the treatment of gold ore, various electrolytic methods, chiefly based upon the solvent action of electrolytic *chlorine*, had been proposed and worked; but the purely chemical cyanide process has largely, if not wholly, superseded these electrolytic methods for the primary treatment of gold ore. Messrs. Siemens & Halske, however, have patented and successfully introduced a method for treating the cyanide liquors from the tailings, or waste sludges, produced in cyanide gold extraction, and containing a very small amount of gold. An extremely dilute solution of cyanide is employed to dissolve the gold. This is afterwards subjected to electrolysis, with iron anodes and thin lead cathodes, with a current density of one or two-tenths of an ampere per square foot. This results in an almost complete recovery of the gold in an adherent form upon the lead cathode. When the required amount of gold has been deposited, the cathodes are removed, and the gold separated by cupellation. This process appears to be exactly suited to the clean quartzite ore of the Transvaal. Over 1,000,000 tons a year of tailings, such as were formerly discarded as useless, are now profitable treated by this process.

Zinc Extraction.

The extraction of zinc from its ores by electrolysis is a problem, on the solution of which much ingenuity and a considerable amount of money have been expended. It is a tempting problem, inasmuch as the method in common use of reducing the native sulphide or the carbonate of zinc to the state of oxide by calcination, mixing this with non-bituminous coal, and distilling in clay retorts at an extremely high temperature, is absolutely barbaric in its primitiveness and its wastefulness.

A step has been recently taken towards this object by means of a process (the invention of Dr. Hoepfner) at present being worked by Messrs. Brunner & Mond. In this process zinc chloride is electrolysed; the products are chlorine and zinc. Such zinc is purer than ordinary commercial zinc, and will no doubt be welcomed by the users of zinc in primary batteries.

For the electrolytic treatment of that hitherto intractable class of ore such as the Broken Hill Mine produces—the mixed sulphides of lead and zinc—two processes deserve mention—one, the Ashcroft process, because very extensive preparations have been made for carrying it out on a large scale; and the other, that of Cowper-Coles.

These bold attempts in new directions deserve success.

Aluminium Extraction.

One of the largest, the most important, and in many respects the most interesting of the electro-chemical industries is that of the production of aluminium. In 1855 the price of aluminium was not far from the price of *silver*, when silver was twice its present value. Now, bulk for bulk, it is the price of *copper*. It is no longer bought by the *ounce*, but by the *pound* or *ton*. The full measure of change has been brought about by the employment of electrolytic extraction. It is an instance of an electrolytic method displacing a thoroughly elaborated and established chemical method, and of the enormous increase in demand that has followed a reduction of price. The production at the present time is, I estimate, not less than 2,000 tons a year. At least 10,000 horse-power is absorbed in this industry alone, and power to double that amount is about to be applied to it. There is every probability that new uses will be found for the metal, and that the manufacture will become a much larger one than it is at present.

Although English enterprise was prompt to adopt and improve the original chemical process, the production of aluminium had wholly departed from us until the British Aluminium Company recommenced the manufacture in the electrolytic form, across the Border, attracted there by the advantage of cheap water power.

The process by which aluminium is extracted, in *America*, on the *Continent*, and in *Scotland* to-day, is in principle exactly similar to that by which Davy extracted potassium from potash 92 *years ago*. The electrolyte is kept in a state of fusion by the electrically generated heat. There are nominally two processes in use, but the difference is extremely small—chiefly a slight difference in the composition of the electrolyte. That known as Hall's process has as its distinctive feature an electrolytic bath composed of potassium fluoride in which alumina prepared from bauxite is continuously dissolved; while in

Heroult's process the solvent of the alumina consists of cryolite, the double fluoride of aluminium and sodium. The electrolytic furnace consists of a carbon-lined iron box connected with the negative pole of a dynamo; this contains the electrolytic bath. Massive blocks of carbon are connected with the other terminal of the dynamo, and form the positive pole. These are immersed in the bath of fused material, and nearly reach the bottom.

The carbon used in the manufacture of the anodes and for lining the furnace is required to be of great purity and hardness. The current density employed is very large—about 700 amperes per square foot of cathode surface, about 8,000 amperes per cell. A difference of potential of 5 volts is maintained between the electrodes. In practice, 14 electrical horse-power hours are expended in the production of 1 lb. of aluminium. If a mean pressure of 5 volts is assumed, the theoretical yield should be nearly one-third of a pound more; there is, therefore, some secondary and wasteful action as well as true electrolytic action going on, and room for further economy.

Sodium Extraction.

The experiment by which Davy set free the few minute globules of metallic potassium in the little pool of fused potash has to-day its fruition in the electrolytic process of Castner for the extraction of *sodium*. In the Castner sodium process an electrolyte of fused caustic soda is employed, with an anode of iron and a cathode of copper. The sodium is reduced at a comparatively low temperature, and while in a fused state is run off into moulds. By this process there is produced in one works 260 tons of sodium a year.

Sodium is also extracted electrolytically in Germany, and, I believe, in America. The electrolytic process of sodium extraction is so much more economical than the chemical process as to have almost completely displaced it.

Electrolytic Alkali Production.

I now come to perhaps the most important of all the applications of electro-chemistry at present engaging the attention of chemical and electrical engineers, namely, its application to the alkali manufacture.

There are now several processes in commercial operation for the production of caustic alkali, and chlorine from brine.

In the process of Holland and Richardson brine is electrolysed in a tank divided into anode and cathode compartments by impermeable partitions reaching nearly down to the bottom of the tank. The anode compartment is enclosed, and provided with a flue for conducting the chlorine to bleaching powder chambers. Carbon anodes and iron cathodes are used. During electrolysis the caustic alkali formed at the cathode dissolves, sinks down to the bottom of the tank, and is drawn off; this alkaline solution is subsequently evaporated and fused.

A somewhat similar process has been introduced by Messrs. Hargreaves and Bird for the manufacture of bleaching powder and alkaline carbonates.

In the process of Hulin—in which brine is electrolysed for the process of soda and chlorine—the anode and cathode are both of carbon, but the carbon cathode is in the form of a thin porous partition. The peculiarity of the process is the percolation through the cathode partition of the stratum of the electrolyte in contact with it. This portion of the electrolyte is most strongly charged with alkali, and is forced slowly through the diaphragm by slight pressure on the surface of the bath, caused by restraining the escape of chlorine.

In the processes described, considerable loss and many disadvantages arise from imperfect separation of the products of the electrolytic action at the anode and cathode. There have been a number of inventions with a view to avoid this defect. The apparatus of Castner and Kellner is one that grapples with the difficulty in a most ingenious and effective manner, and it is especially entitled to notice because it is already in extensive commercial use. 10,000 tons of caustic soda and over 20,000 tons of bleaching powder will be produced by it this year.

The elementary apparatus consists of a shallow rectangular slate trough, divided into three compartments by two partitions. These cross the trough from side to side, but do not quite reach the bottom, which is grooved to form a shallow gutter under each partition. The partitions dip into the gutters sufficiently deeply to ensure complete isolation of the three compartments when the gutters are filled to the level of the bottom of the trough with mercury. During operation the mercury not only fills the gutters, but extends in a thin stratum over the bottom of the trough. The trough is so mounted that a slow and extremely slight oscillatory movement is given to it. This results, when one end is tilted up, in the stratum of mercury on the bottom running out of the upper end compartment into the middle compartment. The alternate rise and fall of the ends of the trough is so small that the movement is almost imperceptible, but it is sufficient to cause the mercury in the compartment at the raised end to run into the middle compartment, and that from the middle compartment into the lower end compartment; that is to say, there is an alternate flow of mercury from end to end, which alternately leaves the raised end compartments denuded of mercury, but the floor of the middle compartment and of one of the end compartments are always covered with mercury. The grooves into which the partitions dip always contain mercury, and completely prevent the mixing of the electrolyte in the three compartments. The two end compartments contain brine and carbon anodes, and the centre compartment an iron cathode and water. The anode compartments are covered with glass, and provided with pipes for the conveyance away of chlorine to bleaching powder chambers. During the working of the process, sodium is deposited upon the mercury, with which it instantly amalgamates; the tank is then tilted until the mercury in an anode compartment runs into the cathode compartment, where the sodium is oxidised and dissolved by the water. The current generated by the oxidation and solution of the sodium helps to reduce the power required for electrolysis; for it will be seen that the sheet of mercury lying on the floor of the trough and divided by the partition is always negative in the end compartments and positive in the middle compartment relatively to the opposed electrodes.

The chlorine evolved at the anode is, so far, entirely used for the manufacture of bleaching powder. The caustic soda produced by this process is of great purity.

Closely resembling the Castner-Kellner apparatus is that lately invented by Rhodin, in which the mercury-sealed anode compartments are capable of being rotated, and the construction is such that external heating may be applied, a higher current density employed, and such temperature conditions maintained as are necessary for obtaining the best result.

Electrolytic chlorine is also extensively applied to the production of chlorate of potash. The manufacture of chlorate of potash by electrolysis is performed in a tank divided by a porous partition, with very thin iridio-platinum anodes and iron cathodes. The electrolyte in the anode compartment is usually a solution of chloride of potassium maintained at a temperature of 45° to 50° C. The solution from the cathode compartment containing caustic potash is continuously supplied to the anode compartment, where the potash absorbs the chlorine, with the production of hypochlorite, which is almost immediately decomposed, with the formation of chloride and chlorate of potassium. The chlorate is removed from the electrolyte in crystals. The yield of chlorate of potash is about 1 lb. per 5 electrical horse-power-hours—nearly 45 per cent. of the theoretical amount. In Switzerland and in Sweden chlorate of potash is now largely produced electrolytically by water power. I am informed on very good authority that preparations are in progress for a large increase of production, and that there is no question as to the electrolytic method entirely superseding the purely chemical method.

Electro-thermal Processes.

The electro-chemical processes I have so far described or referred to are all of them of the electrolytic kind. There are other electro-chemical processes which are not electrolytic, but which are important, and deserve mention. I refer, in the first place, to a group of processes and effects which depend on the principle of dissociation and combination at extremely high temperatures, and which involve the employment of the electric furnace, first suggested and applied experimentally by Sir William Siemens.

In this class is included the electro-thermal manufacture of phosphorus; also that most useful and interesting polishing and cutting material next in hardness to the diamond, carborundum—the invention of Mr. Acheson.

Mr. Acheson has developed the size of the electric furnace to enormous proportions, and made it yield results of great industrial value. Amongst these I must mention incidentally—for it is not a chemical, but a physical action—the complete transformation of amorphous carbon into graphitic carbon. It is not new to produce this transformation on a small scale, but to completely convert large masses of carbon into graphite is both new and of great importance.

It is well known that blocks of carbon as ordinarily manufactured, when used as anodes in an electrolytic cell, rapidly disintegrate; and until now this has been a serious difficulty in the construction of electrolytic apparatus like that of Castner-Kellner. This difficulty is completely met by the use of graphite anodes, into which ordinary amorphous carbon anodes are now being transformed by the electric furnace.

Some idea of the scale of these electric-furnace operations may be formed when it is realised that 1,000 electrical horse-power for 36 hours is expended in one heating.

To the same class of electro-thermal products belong carbide of calcium and a great number of analogous products, first obtained by M. Moissan by means of the electric furnace, employed with the most admirable skill, guided by thorough scientific knowledge, and the exercise of that kind of imagination which apprehends and realises far-off possibilities. I am informed by Mr. Worth, of the Acetylene Company, that carbide of calcium is now being manufactured at the rate of probably 20,000 tons per annum. Considering the value of this substance as a means of easily generating the highly illuminating gas, acetylene, and other products, there appears to be great probability of this manufacture becoming much larger.

Ozone Manufacture.

I must not omit to mention a quite different order of electro-chemical effects, in which alternate or intermittent currents of high tension are employed to induce the formation of ozone. By means of ozone, secondary chemical effects of great value are obtained; among these I may mention the manufacture of vanillin and heliotropine, now established manufactures.

Ozone has also been applied to wax bleaching, and to the thickening and bleaching of oils, and to a number of other important uses.

Prospects of the Electro-Chemical Industry.

Although I have but touched the fringe of this matter, I will not weary you with further examples of the value and extent of the applications of electricity to chemical manufactures. I have shown that already there is a large amount of valuable electro-chemical work being done, and that there is a limitless prospect of expansion.

Looking at the immediate future, many interesting questions present themselves, which must be considered, even though we may not be able to completely answer them. Amongst these are the questions, To what extent, and in what cases, are electro-chemical methods likely to supplant old-established chemical methods? And it is not too soon to ask where, and by what means, will the new electrolytic manufactures be ultimately carried on?

Will the introduction of electro-chemical methods of manufacture uproot the old manufactures from their ancient habitat?

In the time that has passed, Britain has enjoyed in chemical manufactures a great advantage in the possession of an abundance of coal.

We are about, in some measure, to lose the benefit of this advantage through the innovations of electro-chemistry.

Whether we profit or lose by the change, largely depends on our readiness or unreadiness to adapt ourselves to the new order of things.

Whatever happens, nothing can be more certain than this—that the electrical engineer who adds to the ordinary knowledge of his profession a competent knowledge of the principles of electro-chemical practice in manufacturing operations, is thereby making broader and surer his path to success.

Addendum—Ratio of Cost of Power to Production in Electrolytic Manufactures.

Material.	Electrical Horse-Power-Hours consumed in the Production of 1 Lb.	Cost of Power to produce 1 Lb. with 1 E.H.P. at £5 and £10 a Year.	
		At £5	At £10
		Pence.	Pence.
Aluminium	14	1·75	3·5
Nickel	1	0·13	0·26
Sodium	3·33	0·41	0·82
Caustic soda + 2½ lbs. bleaching powder	2·7	0·33	0·66
Chlorate of potash	5	0·62	1·24
Zinc extraction	1	0·13	0·26
Copper „	0·5	0·065	0·13
Copper refining	0·25	0·032	0·064

PHYSICAL SOCIETY.

Ordinary Meeting, January 21st, 1898.

Mr. Shelford Bidwell, President, in the chair.

Prof. Fitzgerald exhibited some photographs by Mr. Preston in illustration of the Zeeman effect for various cases, including those of iron, cadmium, zinc, and sodium. These photographs, and the method of obtaining them, have already been described. The cause of doubling is now attributed by Prof. Fitzgerald to absorption by the surrounding vapour. In a particular case he examined a double line that exists in one of the photographs. Under the polariser the two lines are at first distinctly seen; but when the polariser is turned, a thin line appears in the middle, and this central line is therefore circularly polarised in a direction opposite to that of the outer pair of lines. The reason for the appearance of doubling in the first position of the polariser is that the central line is there completely absorbed out by the surrounding vapour.

Prof. Oliver Lodge then gave a communication concerning his work on "Electric Signalling Without Connecting Wires."

From the nature of the oscillatory disturbances emanating from any of the customary forms of Hertz vibrator, syntony has hitherto been only very partially available as a means for discriminating between receivers. There is, in fact, so rapid a decrease in the amplitude of the vibrations that almost any receiver can respond to some extent. Discrimination by syntony is possible with magnetic systems of space telegraphy where the magnetic energy much exceeds the electric, *i.e.*, as between two separated inductive coils; and by the use of such coils, appropriately applied, the author has been able to attain fair syntony even with true Hertz waves—*i.e.*, he has constructed spark-gap oscillators, with sufficient persistence of vibration, and syntonised resonators. The "coherer" principle can be applied to either a purely magnetic or to the Hertzian system. It was first used by Prof. Lodge in devising lightning guards, and afterwards in his magnetic system of telegraphy by inductive circuits, each in series with a Leyden jar; a pair of knobs in near contact, or other overflow gap, being provided in the receiving apparatus. This was the first meaning of a "coherer" in the electrical sense, as used by Prof. Lodge. It referred to a *single* contact between two metal knobs. The term has since been extended by others to the filings-tube of M. Branly, and some confusion has arisen, for M. Branly does not consider that simple coherence and break explains fully the behaviour of his instrument. Prof. Lodge is disposed to agree, for he finds that the resistance of almost any form of coherer varies in rough proportion to the received impulses, and that there are other peculiarities (to be mentioned later); he is, therefore, inclined to think that the action cannot, after all, be entirely explained as due to mere "welding," but that there is something more to be learnt about it. The sensitiveness of a coherer depends upon the number of loose contacts; it is a maximum for a single contact, *i.e.*, for a needle-point lightly touching a steel spring. With this sensitive coherer, hardly any "tapping-back" is required for decoherence, but it wants delicate treatment when properly adjusted, and the greatest current through it should not approach a milliampere. On the other hand, a Branly tube rather improves under rough treatment; in such a tube the author prefers to use iron filings in the best possible vacuum; brass too is very good, but rather less easy to manage. Aluminium is thoroughly bad, and gold, for the opposite reason, will not work, its surface is too clean. Points, or small surfaces for making contact with the filings, are better than large surfaces. The usual method of connecting the coherer across the gap of an ordinary Hertz receiver, in parallel with the telegraph instrument and battery, has the unavoidable objection that they shunt away part of the received oscillations. In the syntonic receiver of Prof. Lodge, which contains no gap but a closed wire coil instead, the difficulty no longer exists; for the coherer can now be in series with the detecting instrument, and in so far as these obstruct the oscillations, they may be shunted out in various ways, as the author describes. The main feature of his new systonised vibrators is this self-inductance coil, whose function it is to prolong the duration of the oscillations, and thereby to render syntony possible. Although such a coil acts disadvantageously, in so far as it possesses resistance, the resistance does not increase so fast as the self-induction. The coil should consist of thick copper of highest conductivity, and it should have maximum inductance for given resistance. For similar reasons, the capacity-areas should also be of highest conductivity, their dimensions should increase outwards from the spark-gap as triangles. The receiver must have no gap, it should be accurately bridged over when a transmitter is used as receiver. The limit of speed of response depends upon the telegraphic instrument. Dr. Muirhead adapted a siphon-recorder to the purpose, because it is one of the quickest responders; he arranged it so that it could be used with intermittent currents, direct. Under these intermittent impulses the siphon trembles; and instead of the ordinary siphon-signals, the slip is marked with dots and dashes. Constant mechanical tremor is usually employed for decoherence, but the author finds that decoherence can be brought about by electrical means, without any mechanical tremor, by connecting the coherer momentarily to a circuit less effective as a collector than that of the proper capacity-areas of the syntonised receiver. The battery and galvanometer detector-circuit may be used for this purpose; the coherer being momentarily connected to it, and while so connected letting it experience an impulse from a distance. Prof. Lodge has designed a revolving commutator, by means of which the coherer can be rapidly changed over from the resonating circuit to the instrument circuit, and finally to the "tapping back" apparatus. A coherer is more sensitive when thus isolated and exposed to the full influence of the received oscillations; the subsequent detection of the effect by altered connections is very convenient for laboratory measurements. A diagram of a series of plotted measurements showed that the resistance of an undisturbed filings tube is approximately a direct function of the intensity of the received stimulus, whether successive stimuli increased or decreased in strength. This electrical process of "tapping back" is to be depended upon, but the process long continued fatigues the tube until a mechanical shake is employed to restore it. Large size apparatus made by Dr. Muirhead for actual distant syntonic work was exhibited, and means were shown for protecting and isolating the coherer when its receiving areas were being used as emitters; also a switch used for changing at one moment all the connections from "sending" to "receiving."

Prof. Threlfall said he had come to the same conclusion as Prof. Lodge as to the advisability of diminishing the number of contact points in the coherer. He had endeavoured to produce longer and more persistent waves, and thus to set afield greater effective energy. It was desirable to keep the waves as parallel as possible. He thought there was some probability that the wave-fronts could be altered and rendered more conformable by a process of diffraction.

Mr. Rutherford also had found it best to work with long waves. He fully appreciated the advantage of increasing the capacity of the oscillator by extending the surface of the metallic plates.

Mr. Campbell Swinton asked whether experiments had been made to verify Hertz results as to the influence of reflectors behind oscillators and receivers. He had found them disadvantageous. A single wire behind either apparatus seemed partially to annul the effect. He also asked whether Prof. Lodge had observed the extraordinary sensitiveness of coherers to small changes of current in neighbouring circuits.

Prof. Lodge, in reply, said he had observed the sensitiveness to slight, sudden variations of current referred to by Mr. Campbell Swinton, for instance, when electric lamps were switched on or off. The effect of mirrors had been studied by Prof. Fitzgerald. They required to be of large dimensions as compared to the oscillator and receiver, otherwise the true reflections were not obtained.

Dr. Silvanus Thompson afterwards exhibited a Tesla oscillator. This apparatus is intended to replace the two induction coils and spark-gap arrangements used by Mr. Tesla for high frequency experiments. It consists of an induction coil with a separate self-inductance coil in the primary circuit. This self-inductance coil is also used as an electro-magnet for the separate interrupter of the primary circuit. A condenser is connected between one end of the primary coil and one terminal of the interrupter, so as to include both of them between its terminals. The primary is a single turn of copper strip, six inches wide. The secondary is one layer of thick wire; each turn separated from the next by an air space. The supply current, about half an ampere, may be taken from the electric light mains at almost any voltage from 50 to 200, direct or alternating.

Prof. Lodge said it would work quite well at 10 volts. He pointed out, also, that if the straight discharge rods at the spark-gap were free to slide, the discharge drove them back into their sockets.

Prof. Fitzgerald said it was stated at Toronto that the spark was broken at the interrupter when the condenser was charged, and that by the time the condenser was ready to discharge, the contact at the interrupter had been made again. It seemed to him that the condenser discharges and surgings must take place at a rate far higher

than the period of the mechanical movement of the interrupter. The condenser charges and discharges were very rapid. It was not what is ordinarily called the "time constant" that was involved, for that only referred to constant voltage. Here the voltage was changing very rapidly indeed.

Prof. Herschel asked if such an apparatus was suitable for work with Röntgen rays.

Dr. Thompson, in reply, congratulated Mr. Tesla upon the perfect working and compactness of his invention. The present form was not suited for Röntgen ray experiments, but Mr. Tesla had designed a special coil that was excellent for that purpose.

The President proposed votes of thanks, and the meeting was adjourned until February 11th.

NOTES ON THE ELECTRO-CHEMICAL TREATMENT OF AURIFEROUS ORES.

The object of the gold mining industry is to obtain the precious metal from its ores in the simplest, cheapest, and most efficient manner. First, the ores are pulverised, then the gold which they contain has to be absorbed by mercury, or dissolved by chlorine, bromine, cyanide, or their compounds, or by other solvents; then comes the operation for the recovery of gold by distillation of amalgams, precipitation by chemicals, or by electro-deposition.

Is the *rôle* of electricity confined to the precipitation of the metal or does it assist in dissolving gold?

Major-General C. E. Webber, read on the 28th ult., at the Institution of Electrical Engineers, a paper on "Notes on the Electro-chemical Treatment of Ores containing the Precious Metals," in which he says that "the precipitation of gold and silver with the aid of the electric current has a history which may help his audience to appreciate the present situation of a question which cannot be devoid of interest to the members of the Institution of Electrical Engineers."

This preamble sounded well and looked very promising for electro-metallurgists, who expected that some light would be thrown on the influence of electrolysis on auriferous ores in a dissolving liquid containing either chlorine, bromine, cyanide of potassium, chloro or bromo-cyanogen.

Major-General Webber passed in review a legion of patents, and went back to Becquerel (1835), Crosse (1837), Prince Bagration (1844), who "described in the *Bulletin de l'Académie des Sciences de Saint Pétersbourg*, some experiments with finely divided gold dissolved in an aqueous solution of potassium cyanide under the influence of the galvanic current, by which means he precipitated the precious metal on a copper cathode."

With all due respect to the gallant Major-General, this is a little error. Bagration noticed that gold was soluble in an aqueous solution of cyanide of potassium *without*, and not *under the influence* of the galvanic current.

Next comes Rae, whose process is incorrectly described by Major-General Webber, who confines himself to the mechanical details of the electrolytical apparatus, while the only important electro-chemical question is the statement made by Rae, that he made use of the combined action of the current of electricity and of suitable liquids, such as cyanide, so that by the action of cyanide the metal is *reduced*, and can then be collected. What Rae says is that "under the influence of the current, the action of the chemicals is *materially facilitated*, and from the solutions, the precious metals are precipitated on the cathode."

Here we have the whole thing in a nutshell! Does the current aid the cyanide of potassium in dissolving the gold, or is it the cyanide of potassium alone, which dissolves the gold without any aid from the electric current, the action of which is simply to deposit the gold dissolved by the cyanide of potassium on the cathodes?

If the electric current does not accelerate the dissolving action of the cyanide of potassium or other similar chemical agents, we shall have done at once with all the processes in which a gold dissolving bath is supposed to accelerate the exhaustion of the auriferous ores when in conjunction with the electric current. The author has not ventilated this question, and we do not hesitate to say that this is to be regretted.

He tells us, and this we accept as a fact, that the Breakwell and Haycraft electro-amalgamator is a copy of the Rae system, except that they "use *no solvent* of the precious metals present in the mixture under treatment."

There is, however, a little mistake in this statement, since if the cyanide of potassium in Rae's apparatus dissolves the gold, the electric current is merely an agent for precipitation, and it would be much more practical to dissolve the gold in one tank and to precipitate it in another. In an electro-amalgamator, on the contrary, the current helps immensely the absorption by a mercurial cathode of the fine and coarse gold.

It may be that in 1888 "MacArthur and Forrest neglected or discarded the assistance of electricity in combination with a weak solution of cyanide of potassium because of the great expenditure of chemicals which they alleged to be the result," but they know better now, and there are already several MacArthur patents for the electro-deposition of gold from its cyanide solutions.

What is the use of the very dry abridgments of the Body and Hannay specifications?

Major-General Webber states that the Breakwell and Haycraft apparatus is the first example in which the bottom of the vessel, described as of basin shape containing mercury, as in the case of the ordinary amalgamating pan, is also the cathode. Here again he is misinformed; has he never heard of the electro-amalgamator, invented by the French engineer Basin who died a fortnight ago?

At all events, he ought to know Nolf and Pioche, and also Partz, who, in their well-known electrolysers, used mercury as a cathode at the same time as Rae invented his electro-amalgamator between 1868 and 1869.

Here is a more serious blunder:—Major-General Webber modifies and distorts the text of the Molloy specification and states that "he dissolves gold by means of bromine, chlorine, cyanogen or *other compounds*." Bromine, chlorine, iodine, are not compounds, and the characteristic feature of the Molloy process is the employment of bromine, chlorine, iodine *and cyanogen* or their *compounds* as solvents of gold. Accuracy is as much indispensable as impartiality for critics. If the version of the Past-President of the Institution of Electrical Engineers is correct, how could Molloy maintain that he was the first to think of the bromo-cyanogen as a solvent of gold?

We still fail to see where we are driven by the lecturer, who goes on quoting patents such as that of Kendall, who added barium peroxide to a cyanide of potassium solution, or to use the *ipsissima verba* of Major-General Webber, who "treated pulverised ores with peroxide of barium and a suitable cyanide in a *water solution!!*"

Then comes Pielsticker, who treats the ores with a solution of cyanide of potassium in conjunction with an electric current of low tension, and with circulation of the liquid through the space between the electrodes which are fixed respectively, the anode to the bottom, and the cathode to the top, of the tank. This time, we were, so to speak, entitled to have the opinion of Major-General Webber on this claim, identical with the theory of J. Rae, viz.: that the precious metals are attacked more energetically by a cyanide solution in connection with a current of electricity than without. But this question appears to be immaterial to the learned author, who simply says:

"To recapitulate: This process has, in common with Rae and his successors, the combination of a solution of potassium cyanide with an electric current, by which it assists solution and effects precipitation on a cathode; and, in common with Molloy, it effects the treatment in more than one stage, and by means of 'circulation.' In this latter respect Molloy and Pielsticker are at one with the process of Siemens & Halske, in contradistinction to the processes in which 'agitation' is essential. With reference to my observations further on as to 'agitation,' it may be here observed that in such processes the density of the sludge at various points in the system of circulation must depend on its rate of motion."

What is the resemblance to be found between the arrangement of Pielsticker, who has a mass of ore between his electrodes, and that of Molloy, who has a layer of mercury over which the gold solution passes, or the large Siemens vats where a large volume of weak gold solution passes between numerous electrodes close to each other, and circulates at a rate of more than 5,000 gallons per hour?

We must congratulate Major-General Webber upon the chivalrous generosity which made him spare us the tedious detailed description of all the existing patents for the use of the electric current in combination with mercury, cyanide of potassium, and halogens. Those processes and their theories are not new things for electricians, and the Institution of Electrical Engineers is not quite the proper place for their discussion. This is not a paper on electro-chemical treatment of ores; it looks more like a report on a mongrel patent with a view to prove that, although there are many breeds in it, as a whole it is not similar to any of them. We can only compare this paper to the "Notes on the Treatment of Gold Ores," a book in which, about 10 years ago, Florence O'Driscoll depicted all the patents for the chlorination of auriferous ores, which he said were superseded by the Newbery-Vautin system, with this difference, however, that the book was extremely interesting, while we cannot say the same of the paper on the electro-chemical treatment of ores, the sole object of which seems to be to enable the author to speak highly of the Pelatan-Clerici process.

"In this we have, I believe, for the first time, a process and apparatus which effectively combines, in a way that can be constructed and worked by a workman of average intelligence, the following:—

"(1) A vat made of a material, dielectric in its nature; (2) an agitating apparatus of various specific forms, each form calculated to carry out one and the same process—being the result of considerable experience—having an agitator, part of which constitutes the anode in an electrolytic circuit, which is carried so that it can by no means make contact with the bottom or sides of the vat; (3) the presence of a cathode, which covers the whole of the bottom of the vat, made of a metal (preferably copper) plate or sheet, and suitably contained and fixed so as to carry on it a layer of mercury; (4) the use of a graduated current from an electrical generator, having large quantity and low potential; (5) the mixture or sludge under treatment being composed of water in given proportions, ore finely pulverised, potassium cyanide or other solvent of gold and silver, and common salt, with the addition as required during the process of alkalies or organic acids as may be required."

We would welcome a paper depicting the progress and the actual state of the electro-metallurgy of gold, or describing a new, simple, and original process for the extraction of the precious metals from their ores, but this lengthy panegyric of an electro-cyano-chloro-mercurial method does not contain much beyond the ancient history of patents which have been dead, buried and forgotten for a long time, to which are added the descriptions of the Molloy, Hayward, Danckwardt, Clark, Keith and other apparatus, and finally of the

Pelatan-Clerici installation. Here and there are a few chemical equations with which every electro-chemist is acquainted and which are to be found in specifications or in books on electrolysis, and also a little dissertation on the fouling of mercury.

This evidently is the electro-chemical budget of the report, and it strikes us at almost every paragraph that we have already read it somewhere. With regard to the Pelatan-Clerici process itself, nothing can be said in favour of a combination of ores, kept agitated over a mercury cathode in a solution of cyanide of potassium and chloride of sodium.

It is a complication more than an improvement; Major-General Webber has valiantly made great efforts to prove that his favourite system is different from the others which he has described, and we do not pretend that he has not succeeded in doing it, but he has altogether failed in his attempt to show that, from the technical point of view, the Pelatan-Clerici apparatus is constructed according to the canons of electro-metallurgy. We sincerely regret to have to perform the unpleasant duty of criticising this lecture, but we do not see how we could have acted differently: silence would be interpreted as the recognition of the excellence of a process which no competent man will recommend as a sound application of the electric current to the extraction of gold. We do not, in any way, say that the Pelatan-Clerici system is not an efficient one, that it does not extract the maximum of the precious metals contained in the ores; we vaguely know that it has been worked about two years at the Delamar mine; its merits or demerits as a gold extractor have nothing to do with us, we simply look on it as an electro-chemical apparatus, and it strikes us as being a very faulty one, almost as bad, and perhaps worse, than those in which carbon anodes are used as stirrers of the ore. In the present case we have a metallic agitator which acts as an anode, and the sole fact of using a metallic anode in hard and constant contact with the ores in a solution which consists of chlorine and cyanide of potassium, is a breach of the laws of commercial electrolysis, especially when currents, such as those stated by Major-General Webber, pass through the electrolyte. He finds it quite natural that the potential must be between 5 and 14 volts for a vat of 9 feet interior diameter, capable of treating 2½ tons of ore per shift of 12 hours, total 5 tons per day of 24 hours, and he informs us that the potential must be governed by resistances "fixed" in the circuit of each vat.

He further makes this remark that "the quantity is regulated by the resistance in that part of the external circuit which lies between the electrodes. Provision is made for a minimum quantity of 1½ amperes per square foot, being half the sum of the cathode and anode together in square feet," thus, if that area is equal to 52 square feet, the current should not be less, and not much more, than 39 amperes.

When the voltage is high and the current heavy, there is no economic extraction of gold and there is no good deposition of gold.

Evidently there is something wrong in such an arrangement; a rather large proportion of cyanide of potassium is used; then some specific oxidising agents and chloride of sodium are added to increase the conductivity: and, nevertheless, this electro-chemical process requires 14 volts and 1½ amperes per square foot. This is preposterous! And, leaving aside the question of the enormous consumption of cyanide of potassium, no man who understands the application of electricity to the extraction of precious metals, would, for a moment, entertain the extravagant idea of adopting such an electrolytic apparatus, in which the expenditure for the electric current is considerable, and, besides, necessitates a costly installation of motive power for stirring the ore in the vats.

We do not insist on the drawback of the agitation of the ores; we do not even ask whether or not the quicksilver is broken up by the sand with which it mixes, with subsequent loss of mercury and gold; but it does not seem that Major-General Webber has gone very deeply into the investigation of the electro-chemistry of the process. We do not even discuss the value of the following theory:

"The expressions I have used—namely, 'reduction of resistance' and 'increase of conductivity'—are useful because they are easily understood; but, be it remembered, they are not correct as applied to the solvent, *i.e.*, water. Indeed, these descriptions of the effect of the mixture of sodium chloride in a solution, and then placing that solution between an anode and a cathode, is scientifically inaccurate. What happens to the sodium chloride in solution in the water is, that it is disintegrated and re-formed, and thus it becomes the intermediary by which, at the instant that chlorine gas and sodium are set free, the current is enabled to 'communicate' between the electrodes."

Each one of those who listened to the paper know what takes place in the electrolysis of a chloride of sodium solution in presence of mercury cathode. We also know, as Major-General Webber says, that: "In the first place, one might expect the nascent chlorine to attack some of the baser metallic ores present in a finely divided state. For instance, sulphides, selenides, arsenides, &c., often attached to particles of gold or silver, would be so attacked; the chlorine uniting with the metallic base iron (Fe) or copper (Cu)." But what we are certain takes place at the same time, is the corrosion, disintegration and destruction of the metallic anode. With such a powerful current as the one used by Pelatan-Clerici, the anode cannot last long.

There would have been a really startling actuality in the "Notes on the Electro-chemical Treatment of Ores" if Major-General Webber had introduced in his memoir the subject of the two electrolytic methods for which their respective promoters claim at present the most marvellous properties. One is the Electro-bromine process which would have evidently called for some instructive comments, the other one is the Chloro-cyanide method, which would suggest many interesting remarks. As they are, the "Notes on the Electro-chemical Treatment of Ores" do not seem to present an essential character of utility for the electrical profession.

A SURVEY OF THE POSSIBILITIES OF ELECTRIC HEATING AND COOKING.*

By W. P. ADAMS, A.K.C., A.I.E.E.

My desire this evening is, if possible, to pave the way to a better understanding of the possibilities of electric heating so that engineers may be able to assume that confidence as to its merits which is necessary before any real progress can be attained, and which is at present lacking in many a professional mind. The feeling is general that the cost is, and will be to the end of the chapter, so great that its adoption can only be hoped for by those of more than ample means, but I hope to show that, while it undoubtedly deserves to rank as a luxury, it will be well within the means of those with average incomes when the cost of current is somewhat modified. The reason why electric heating, more especially in the direction of cooking, is able to compare favourably with other methods, is, that the heat can be applied just where it is required, and there is remarkably little waste.

Heating appliances do absorb what appears to be a large amount of electricity, and many electricians, especially those more closely connected with electric lighting, are surprised at the large amount of current which is necessary for cooking purposes, and mentally compare what might be done with the same current if devoted to the production of electric light.

As it is in the direction of electric cooking that I anticipate the largest development in the near future, I shall confine myself at first to a consideration of this subject.

In a kitchen suitable for supplying the needs of a family of from 8 to 10 persons the following apparatus would be necessary: Oven, absorbing 2,500 watts when heating up for about 15 minutes, and on the average about 1,200 watts afterwards. Breakfast cooker, wound for two circuits, each absorbing 600 watts. Two grillers, each wound for 500 watts. Two frying-pans, also wound for 500 watts, and several hot plates for warming ordinary saucepans, or in place of these several self-contained electric saucepans. These plates or saucepans would probably absorb 1,500 watts together. The household supplied from such a kitchen would probably have a maximum demand for not more than 2,500 watts for lighting purposes. The total watts which could be absorbed by the cooking apparatus is 7,200. It must, however, be borne in mind that these various appliances are used at different times, and never altogether.

We shall now consider the difficulties in the way of the adoption of electric cooking. First and foremost is the question of the cost of current. This is all important. In addition to this the first outlay cannot be overlooked, owing to the rather high cost of the apparatus.

The largest field for the development of electric cooking is undoubtedly in private houses supplied from central stations, and if there is to be any large extension in this direction the central stations must be prepared to supply current at a more moderate price than is now charged for lighting. It is generally recognised that electric cooking will eventually prove to be the means of solving the much-vexed question of securing a day load for central stations; and, in view of this fact, many of the central stations offer special terms for supplying electric currents for heating. A number of the central station engineers are, however, still doubtful as to the advantage of adopting electric heating, partly owing to the question of the load overlapping the lighting load. This question I shall touch on later, but I would venture to point out that, if the demand is spread over a sufficient number of hours, electric heating is worthy of consideration quite apart from electric lighting, and it would therefore pay to put down extra plant to meet the additional demand. In fact, I do not think the day is far removed when the demand for current for electric heating will vastly exceed that for lighting purposes; and I submit that the solution of the question lies mainly in the hands of the present suppliers of electricity. If they are prepared to adopt a liberal policy of supplying electricity for heating purposes, perhaps at little more than the actual bare cost, they will very soon find that the improved conditions under which they run their plant will begin to repay them handsomely.

The price to be charged is of the greatest importance, and I will, therefore, make a few comments upon the methods of charging now in vogue. It is becoming usual to make the charge for heating and power about half that made for light. A very usual figure is 3d. per unit, while some supplies have brought the price down to an even lower figure. I may say at once that the ideal to be aimed at for heating and power purposes is a charge of 1d. per unit, and although it is only possible at present for one or two companies to charge such a figure and cover the bare cost of production, I think the figure is well within the range of practicability, and with a rapidly growing load on supply stations, I think it will soon become general. It is noticeable that the local authorities are moving more rapidly in this direction than supply companies. I would commend this to the attention of the supply companies. Their policy of making high charges is, to say the least of it, unprogressive. Only about four are charging so little as 3d., while 26 of the local authorities supply at 3d. or less, 13 of these charge 2½d. and less.

The Wright system of charging for electricity appears to be securing considerable support amongst central station engineers, and the maximum demand system seems to have been receiving even greater favour. With both of these systems I can foresee a trouble in connection with the supply of electricity for heating purposes.

Under the Wright system it is conceivable that the demand meter

* Abstract of paper read before the Northern Society of Electrical Engineers.

may run up to a most unusual height, through the inconsiderate switching on of a number of the heating appliances together, the indicator therefore furnishing quite an abnormal record upon which the charges are to be based. Again, with the maximum demand system, if the charges are to be made upon the usual understanding that the whole apparatus is to be run for an hour at the maximum charge before any reduction is made, the charge cannot come down to anything like a reasonable figure. It is, of course, obvious that the whole of the appliances will not be in use together, and I think this point is worthy of close consideration.

In a certain kitchen it was found that the various cooking appliances were in use for from five to seven hours a day, during which time the highest point reached was 1·5 kilowatts. The average consumption during the day was from 8 units. It will thus be seen that if generating plant to the capacity of 2 kilowatts was installed for supplying these cooking appliances, it would have an earning capacity of about 1,400 units per kilowatt installed per annum.

I find that the number of units sold per annum per kilowatt of plant installed varies considerably among the different stations in country towns where the load is almost exclusively a lighting one and the supply is very small during the day time; about 400 or 500 units represent the work done during a year by one kilowatt of plant installed. In the larger towns, where there is probably a small day supply for power as well as one for lighting in dark offices and basements, the demand is larger. In Brighton, 840; Edinburgh, 640; Glasgow, 696; Manchester, 700. It will be seen that Brighton, which might also be termed a country town, as there are no factories there to absorb power in the day, shows the best results of those named. This, I think, is traceable to the moderate nature of the charge for current.

As a load for summer time, cooking should prove invaluable to supply stations, and the question of overlapping during this period does not arise.

In winter, however, the conditions will be different. A certain amount of overlapping will occur owing to the prevailing fashion of late dinners, but I submit that the load for electric heating is likely to be of sufficient importance to warrant putting down additional plant to meet this.

Much, of course, depends upon the acuteness of the peak as to how this question is to be met. If it can be arranged, it will be desirable to utilise for heating during the day the plant installed for lighting purposes, but if the demand for heating grows to such an extent as to greatly surpass the lighting load, the question becomes of less importance. It is not, perhaps, within my province at this moment to suggest how this difficulty is to be met, but with some stations in this country the question does not arise at the present time, as ample plant has been installed to meet the lighting requirements and still leave a balance in hand to allow for the overlapping. A number of stations appear to be provided with twice the amount of plant required to meet the maximum demand. Of course, some portion of this is reserve plant, but there still remains a good balance in hand to meet this contingency.

I am inclined to think that a secondary battery would prove of great value in meeting the peak difficulty, as there are several depressions on the day load curve which could be filled up if the generating plant were employed during these times of light load for charging the accumulators. How far it is possible to economically utilise accumulators for this purpose in alternating supply stations is an open question.

While considering the charges made by the various supply companies it is noticeable that several have adopted the enlightened policy of charging for power and heating purposes, a price which is actually less than the total works' cost. Putting on one side for one moment the question of overlapping, it is obvious that this is a right policy to adopt, as, assuming that the plant used for lighting is employed for supplying heating appliances, the charge for rent, management, &c., will remain practically the same.

I have the misfortune to be situated in a district served by the City of London Company, which company holds a monopoly and takes advantage of this to maintain a charge which is worthy of the very early days of electric supply. Although their works' cost compares anything but favourably with other large towns, having in many cases a much smaller output, I think you will agree with me that the charge of 8d. is somewhat extravagant, and I may say that such a charge absolutely prohibits any demand for current for power and heating purposes. It is true that a rebate is made if more than a stated quantity of electricity is used, but this is fixed so that it is of little value in the way of reducing the price.

It seems almost incredible that, in these enlightened days, the foremost city in the world should be one of the worst supplied in the matter of electricity.

I have so far made no comparison between the cost of cooking by electricity and that by other means. I shall not deal with this question much in detail, as I think it more practical at the present time if a general idea is given as to what the actual consumption of electricity will be, for the cost by other means varies largely under different circumstances. I have, however, some figures to hand obtained in a kitchen where both gas and electricity could be used at will. The household was a small one, consisting of about five persons, and the consumption of electricity was approximately 30 units per week when cooking was done solely by this agency. When gas was employed exclusively, 1,240 cubic feet of gas were used during a week. The cost, then, of electricity at 2d. per unit is 5s. a week, and of the equivalent amount of gas at 3s. per 1,000 cubic feet is 3s. 9d.

The figures of consumption which I have given above are the most complete at my disposal, and this is my reason for bringing them before your notice, but I have other results to hand which indicate that the consumption of current may be reduced below the figures given when the appliances are used intelligently and with care. For small installations such as we have considered one may assume roughly that a unit per head per diem will suffice for all cooking purposes. These figures will naturally be reduced in larger establishments and experience seems to point to about 1s. 2d. a unit as a sufficient allowance in kitchens where more than 30 or 40 persons have to be provided for. The best results will be obtained where there is a hot water supply. Many of you are probably aware that heating water by electricity is a most uneconomical proceeding, at any rate at the present prices, and where an establishment is sufficiently large it is always recommended that a slow combustion stove is fitted to supply all the hot water for the household. In many houses such a stove is already fitted.

(To be continued.)

THE PACIFIC CABLE.

Letter to the Right Honourable Sir Wilfred Laurier. By Sir Sandford Fleming.

Ottawa, *December 28th*, 1897.

The Right Honourable Sir Wilfred Laurier, Premier.

Sir,—For some months past I have frequently been asked by writers of the press to furnish information respecting the Pacific cable. I have been so applied to, as it is well known that I have long felt the deepest interest in the project, having been appointed by the Canadian Government to take part in the Colonial Conferences of 1887 and 1894, and in the Imperial Committee of 1896. I have invariably declined to comply with the request from the feeling that it was distinctly understood that the proceedings of the investigation by the Imperial Committee should be treated as confidential until made public by Her Majesty's Government. I have, in consequence, felt debarred from alluding either to the evidence obtained by the Committee or to the conclusions submitted in their report, or in the special reports presented to the Canadian Government by the Canadian Commissioners and by myself.

These several documents were presented nearly 12 months ago; since then questions have arisen, which were not considered by the Imperial Committee, and many important facts are also obtainable from other sources, explanations respecting all of which should, I conceive, be communicated to the public.

Since the Imperial Committee closed its investigations, the Conference of Colonial Premiers has been held in London. Among other matters, the Pacific cable was brought before this Conference, and from what has transpired the subject was complicated by a new proposition having been submitted by the Eastern Extension Telegraph Company. Consequently, the consideration of the project was deferred. Six months has since elapsed, and I feel called upon to make known some facts and explanations bearing on the questions which, in my humble judgment, the public should understand. I trust you will approve of the information being given to the public in the form I have now to submit to you.

I have the honour to be,

Your obedient servant,

Sandford Fleming.

The Pacific Cable.

Everywhere it is apparent that the British Empire is being formed by a process of growth and development, and there are many forces actively in operation, all tending to give it shape and strength and distinctive character. Lofty ideals are entertained by men of thought, experience and patriotism; but the future is veiled from us, and we cannot foretell the precise form of relationship which will eventually be assumed by members of the British family of nations in so many meridians of longitude.

If the form of the development to be attained is not clearly foreseen, it can at least be said that the entire British people in all parts of the globe are inspired by a unity of sentiment, and that they are simultaneously moving onwards in one general direction. Progress is the watchword in all quarters. It is impossible not to recognise the advancement perceptible in the colonies of the southern seas, and equally the amazing vitality in British Africa. The Dominion of Canada plays an important part in moulding the destiny of her own people, and in promoting more intimate relationships between the motherland and the colonies.

It is but 30 years since the scattered provinces of British North America became federated in one government. The Dominion thus created inherited many remarkable advantages. It can lay claim to the most important geographical position, owing to its extension between the two great oceans; a position which confers the only means of establishing under the British flag communications between the eastern and western territories of the globe. It enjoys the possession of vast fields of the richest virgin soil, with still unexplored mineral regions of immense extent, and presumably of immense value. The population retains the high qualities of the foremost nations of western Europe, from which it has sprung, and the wide expanse of unoccupied areas leaves ample room for a large accession to its number. These rich possessions of the Dominion give promise, under wise guidance, of a splendid future.

It soon became evident that the development of a country continental in its extent exacted public works of corresponding magnitude. Lines of railway and telegraph were projected from ocean to ocean, and immediately after Confederation, both were proceeded with. In 1874 the policy of establishing the telegraph in advance of the railway was determined upon, and as a corollary to

the trans-continental telegraph the proposal to extend the electric wire across the Pacific naturally followed. It can be said that ever since the telegraph reached the coast of British Columbia the Pacific cable has engaged public attention, and that the necessity of this undertaking has been repeatedly affirmed. It received recognition in the Conference of Representative Colonial Statesmen in London in 1887, in that of Ottawa in 1894, at telegraph and postal conferences in Australasia almost annually, and at various times by Chambers of Commerce at home and abroad.

The dominant idea with those who have most strongly advocated the establishment of a Pacific cable has been the unity of the Empire. They foresaw the difficulty of effecting any practical union between communities separated by distance, so long as they remained without the means of direct and cheap communication. At the same time it was plain to them that a telegraph across the ocean would foster trade and commerce—the life of an Empire such as ours.

Among the memorable gatherings of representative men, not the least important was the Conference of Premiers in London on the occasion of Her Majesty's Diamond Jubilee. Before these statesmen met, hopes had been entertained that some definite action would be determined for the inauguration of the scheme. Preparations had long been made for joint action. It was one of the chief objects set apart for special consideration at the conference of the Imperial and Australasian Governments held at Ottawa in 1894. With this view, the Canadian Government, agreeably to a resolution of the Conference, obtained much information on the subject, and transmitted it to all the governments interested in the projected work. Soon afterwards the Secretary of State for the Colonies (Mr. Chamberlain) invited the Canadian and Australasian Governments to send representatives to London for the purpose of taking part in an Imperial Committee to be appointed specially to receive evidence and consider the project in every detail. The Committee first met on June 5th, 1896, and on January 5th, 1897, they reported the results of an exhaustive inquiry.

The proceedings of the Committee and the conclusions which have been formed have not been made public. They have been repeatedly asked for, but as nothing transpired respecting the labours of the Committee up to the Jubilee week, the opinion gained ground that when the Conference was concluded full information would be given to the public with the decision arrived at by the imperial authorities and the Colonial Premiers. In many quarters it was expected that action would on that occasion be taken, and that the inauguration of the cable would result as a practical outcome of the Queen's Jubilee.

The old proverb tells us that it is often the unexpected which comes to pass. The proceedings of the Conference of Premiers were first made known to the public by an article purporting to be published by authority in the London *Standard* of July 25th, and the subject of the Pacific cable is thus alluded to:—

"The Conference left the Pacific cable scheme in mid-air, and it is very unlikely that anything more will be heard of it for a considerable time. The position was entirely changed by a proposal by the Eastern Extension Telegraph Company to lay an all-British line from Western Australia across the Indian Ocean to Mauritius, thence connecting with the Cape and St. Helena and Ascension. . . . . The Eastern Extension Company, it is understood, does not ask for a direct subsidy for the new lines, but seeks other concessions from the Australasian Governments which, if made, will justify them in proceeding with the work."

In the account of the Conference of Premiers laid before the British Parliament, there is a reference, in two sentences, to the cable, no mention, however, is made of any proposal having been submitted by the Eastern Extension Company. But the Premier of New South Wales (Mr. Reid) returned home from England through Canada, and being interviewed by reporters in Montreal, Toronto, and Vancouver, confirmed the statement with respect to the proposal of the Eastern Extension Company. The character of the concessions asked by the company has not been made public, but it has been stated that they desire to obtain exclusive rights for Australia on condition that they connect the colonies with the Cape and lay a new cable from the Cape to England *via* St. Helena, Ascension Island, Sierra Leone or Bathurst and Gibraltar. This scheme is put forward by the company as a substitute for the Pacific cable.

Owing to the fact that telegraphic connection with the Cape is at present extremely defective, the proposal of the company is undoubtedly of great importance to South Africa.

There are two telegraphic routes from England to Cape Colony. Both have landing stations at Lisbon, one passes through the Mediterranean to Alexandria, through Egypt to Suez, through the Red Sea to Aden, and from Aden the cable follows the east coast of Africa, touching among other points at Mozambique and Delagoa Bay in foreign territory. The other route leaves the first at Lisbon, and follows the west coast of Africa, touching at some 14 points; eight of which are under foreign flags, those of Portugal, France, and Spain.

Interruptions are frequent on both routes. There is evidence to establish that during the past four years communication between England and the Cape has been broken many times, and that the aggregate interruptions have averaged in each year 75 days on the west coast route and 87 days on the east coast route, showing that each cable is unavailable from six to seven days per month. While this refers to the average period that the cables have been thrown out of use, the durations of single interruptions have varied from one to 30 or 40 days. As both lines are liable to be broken at the same time serious inconveniences have not seldom resulted. Everyone will remember this contingency occurring when the Transvaal difficulty was at its height. Intense anxiety was then caused during the cable interruption of 11 days, when South Africa was passing through an acute crisis in her history.

Obviously a new cable to the Cape is much required, and as the frequent interruptions to traffic by the two present routes is to a large extent owing to the fact that the cables are laid in the shallow water which prevails along the African coasts, they are in consequence exposed to accidents to which cables in deep waters are not subjected. That part of the proposal, to touch at St. Helena and Ascension, where the water is of ample depth, would give to the cable the necessary security and avoid the difficulties experienced on the present routes. It is, however, not so clear that the northern half of the new cable would be so fortunate. By landing at Sierra Leone or Bathurst and Gibraltar, and terminating in Cornwall, the cable of necessity would be laid for some distance in shallow seas, where it would be exposed to injury from various causes, and where, too, the agent of an unfriendly nation, or, indeed, an evil-disposed fisherman, would have it in his power to destroy the cable with ease, totally unobserved. For hundreds of miles it would be exposed to such risks.

The question may be asked, would not this proposed new cable from England to the Cape, with an extension to Australia, be of general advantage? To such a question there is but one answer. It certainly would be of general as well as special advantage, for the reason that we cannot have too many lines of communication. They are needed in the every-day business of trade and shipping, and moreover, we must come to recognise that a complete telegraph system, ramifying wherever Her Majesty's wide domain extends, is an essential condition of the life and integrity of the British Empire. It is on this, and on other grounds, impossible to admit the claim of the Eastern Extension Company, that the proposal submitted by them is preferable to a trans-Pacific cable, and that it will render it unnecessary.

At the Colonial Conference of 1894, the outline of a telegraph system for the Empire was submitted. It was not confined to one side of the globe; the system projected, embraced, and encircled its whole extent. The scheme was illustrated by a map of the world, with the chief cable lines laid down upon it. If the proceedings of the Conference be referred to, it will be seen that a trunk line of telegraph was projected from London through Canada to Australasia, with extensions to South Africa, India and China. It was shown that by the Canadian route all the chief British possessions on the four continents would be brought into electric touch with each other, and with the Imperial centre in London. It was demonstrated, moreover, that this result could be accomplished without touching a single acre of foreign soil, and without traversing shallow seas, where cables are most liable to injury from ship's anchors and other causes, and where they can be so easily fished up and destroyed. No fact can with greater confidence be affirmed than that the cables by the Canadian route would be far less vulnerable than the existing cables, or those now projected by the Eastern Extension Company. But even if no advantage in this respect could be claimed, it requires no argument to prove that telegraphic connection between England and Australasia would be infinitely less subject to interruption from accident or wilful injury, by having the Canadian line established, in addition to the Eastern Extension lines, especially as the former would be on the opposite side of the globe, and far removed from the immediate theatre of European complications.

It is not possible to believe that anyone disassociated from, and uninfluenced by, the Eastern Extension Company, can view the proposed Canadian Pacific cable with disfavour. If it be important to strengthening the connection between the United Kingdom and the out-lying portions of the Empire, no one can question its necessity. But the Eastern Extension Company has never taken a friendly view of the Pacific cable. From the first it has been its determined opponent. The proceedings of the Colonial Conferences of 1887 and of 1894 give evidence of this fact. The report on the mission to Australia by the Canadian delegates gives some indication of the intense and persistent antagonism displayed by the company, and the manner in which its powerful influence has been employed to thwart the enterprise. It may not be an unwarranted surmise that the immediate purpose of the company in submitting to the Conference of Premiers their new proposal was to divert attention from the Pacific cable.

(To be continued.)

ELECTRIC LIGHTING AND DUST DESTRUCTORS FOR GLOUCESTER.

The vexed question of the selection of site for the proposed electric light works for Gloucester came before a meeting of the City Council again last week. The matter has been under the consideration of the Council for many months, and even now an essential and governing factor, viz., as to whether electric light works and dust destructor shall be erected in combination, or otherwise, has not been determined. Mr. Hammond, the consulting electrical engineer, attended the Council meeting, and stated that he had, at the suggestion of the Mayor, inspected the sites which had been pointed out to him. With regard to some of them, they were confronted by the question as to the advisability of separating the two projects. At the present time the Council appeared to have made up their minds that the electricity works and the dust destructor should be combined, and it was useless for him to go on viewing sites which were condemned if the decision of the Council were adhered to. If he might venture to say a word on the point, he would recommend them to avoid going past the best site, or what was approximately the best site, for the electricity works, for the sake of the dust destructor, and, although, as he had already pointed out, there were advantages in the combination, yet they might run that combination too far. Personally he would rather not have the dust destructor next door to his electricity works, for the one reason that the dirt and dust

made it more difficult to carry the electricity works on with a dust destructor in the immediate vicinity. Besides they could not keep the machinery and building so smart and tidy as they could if the dust destructor was half a mile away.—The ex-Mayor said Mr. Hammond had stated in committee that the combination of dust destructor and electric light works would mean a saving of £250 per annum. Would the presence of a dust destructor be any danger, or did Mr. Hammond object to it simply because without it the works could be kept cleaner?—Mr. Hammond replied that at Shoreditch the dust considerably interfered with the machinery. The works there were ill designed, and if he were asked to draw up a scheme of combination he should take care that the dust destructor portion was entirely closed up from the electricity works, instead of being connected by windows and doors as at Shoreditch. Of course, he would rather not run the risk of having his smart machinery interfered with, but still he believed those difficulties might be got over, and the saving undoubtedly would be what had been stated.—Mr. C. G. Clark asked if there was any possibility of the dust interfering or damaging the machinery providing the works were properly constructed.—Mr. Hammond replied that an engineer liked to speak from experience, and he must say that the nearest approach to the works not being interfered with was at Cheltenham. There the destructor was separated from the electricity works by a promenade. They had plenty of room there, more than they wanted to take in Gloucester. He knew of no place where a certain amount of dust did not come in. When he recommended the combination he had, of course, considered the *pros* and *cons*, and if they had it they must put up with the disadvantage of some amount of dust, and that would require greater care in cleaning the machinery, because there was nothing so dangerous to electric plant as dust. At Shoreditch some of the machinery was disabled from that cause, but as to whether he could keep it out he would be able to tell them better when he had erected the Gloucester works.

Mr. Clutterbuck, Chairman of the Committee, withdrew the recommendation that the old gasworks site be purchased, after hearing Mr. Hammond's wish to further investigate the question.

The Mayor stated it was useless to discuss the matter further at present. A special meeting of the Council could be called when Mr. Hammond had completed his further investigations.

THE LEYTON DESTRUCTORS.

In last week's "Notes" we briefly alluded to the public inspection of the Leyton sludge and dust destructors, erected at the sewage works by the Beaman and Deas Syndicate, of London and Warrington. In this issue we deal in another place with the general aspects of the destructor question, and here we will just quote sufficient from a paper read by Mr. Liversedge, engineer and director of the syndicate, before the Gloucester Engineering Society on the 18th ult., to enable our readers to understand the construction of the Beaman and Deas plant.

"In the Beaman and Deas destructor each cell of a pair acts alternately as a fume cremator to the other; when the one cell is comparatively green the gases from the other are at their hottest, and with ordinary refuse a minimum temperature of 2,000° F. is maintained in the common combustion chamber where the gases unite, provided only that a reasonable supply of refuse be maintained. It is difficult in working this destructor to avoid one or the other of the pair of cells being in a sufficiently vigorous state of combustion to completely consume, by the gases it throws into the fume combustion chamber, anything whatever of an objectionable character which may happen to be proceeding from its companion. The Beaman and Deas destructor is avowedly, purposely, and openly a quick combustion and high temperature furnace. I submit to you a brick recently, at my request, cut out of the crown of a Beaman and Deas cell which has now been at work for four years, burning rarely less than 15 tons of refuse per day, working continuously day and night for every working day, but allowed to cool down at the end of every week during the whole of that period. It is almost impossible to say by measurement whether the brick has really undergone any wear at all. What happens in this cell appears to be this. As soon as combustion is commenced, particles of siliceous matter, at a very high temperature, are projected against and adhere to the brickwork of the cell. They enter to a certain extent into combination with the material of the bricks, but in doing so they at once form a coating on the surface of the brick, which effectually stops any further action of a corrosive nature. That is to say, there is formed upon the bricks what would doubtless become with a little higher temperature a fine protective enamel, though it actually presents itself as a kind of coke. In practice this crude enamel grows so much more or less in the form of tentacles, that it is necessary from time to time to remove it. It fulfils in my opinion two other useful purposes—it helps to prevent the escape of particles of half charred paper, and assists to mix the gases arising from the drying hearth with those from the fire proper. I submit to you some pieces of this 'enamel.' The temperature by which this effect is produced is necessarily high, doubtless over 3,000° F. The quantity of house refuse which may be effectually destroyed in a pair of Beaman and Deas cells, has been demonstrated to be over 50 tons per day of 24 hours. The normal duty for which the standard pair of cells is supplied is 30 tons, though this amount is often enough exceeded. You will naturally wish to know by what means so large a quantity of refuse can be treated in one of these cells and such high temperature regularly attained. The explanation lies partly in the fact that the combustion is aided by forced draught supplied by fans."

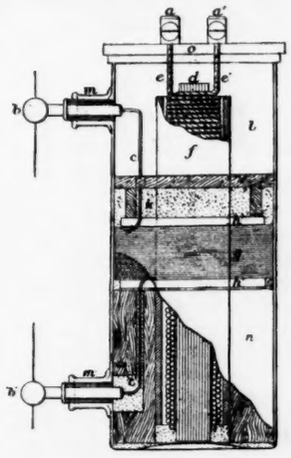
A NEW INDUCTION COIL.

Since the discovery of the Röntgen rays induction coils have acquired a much greater importance. Ruhmkorff's is still the only one in common use. The defects of this coil may be summarised as follows: low efficiency, which hardly amounts to 20 per cent.; high cost of construction both on account of the great weight and cost of the materials employed, and the labour required to wind the enormous length of secondary wire; the delicacy of the apparatus, which is easily damaged by perforation of the insulator or burning of the secondary wire; the great weight of the apparatus which renders transport difficult.

M. De Rochefort-Lucay has studied this question with M. Wydts, and finds that most of these defects are due to imperfect insulation of the secondary wire.*

At the high tensions which are generated in the coil, and which amount, often to as much as 400,000 volts, solid insulators such as glass are in the course of time, very much modified in their molecular constitution, so that in the end they usually break down. In liquid insulators a kind of electric convection takes place.

Viscous or pasty insulators, however, which have neither the porosity of solids, nor the molecular mobility of liquids, offer great advantages. Such insulators are generally hydro-carbons, which decompose slowly under the action of internal electric forces, depositing particles of carbon in suspension which, to a certain extent, reduce the insulating



properties of the material. MM. Rochefort and Wydts have been able, by a special arrangement, to use a viscous insulator without permitting the deposition of carbon.

In their coil, fig. 1, the primary coil is the same as in the ordinary Ruhmkorff coil. It consists of a core of soft iron, d, about which a double layer of thick copper wire, $e\ e'$, which ends at the two terminals, a and a', of the external circuit supplying the current. The primary coil, f, is surrounded by an insulating tube.

The secondary coil consists of a single bobbin, g, containing 600 grammes of copper wire, 0·16 mm. in diameter.

This secondary bobbin is placed round the centre of the primary, and rests upon two tubes of glass, h', supported by a block of wood. A stopper of wood, i, furnished with two brackets, rests on the secondary bobbin, from which, however, it is separated by two tubes of glass, h'.

The two ends of the secondary wire are connected to the two secondary terminals, $b\ b'$, in the stoppers of two necks, $m\ m'$, of the glass vessel in which the whole coil is contained.

The glass vessel is filled with the pasty hydro-carbon insulator.

The apparatus, thus constructed, gives sparks of 20 to 22 cm. in length, with 6 volts and 3·3 amperes (about 20 watts) applied to the primary circuit.

The primary circuit of a Rhumkorff coil giving the same length of spark, would consist of 50 to 60 flat bobbins

* Société des Ingenieurs Civils de France, November 5th, 1897.

coupled in series and separated by partitions of solid insulator. The weight of the secondary wire would be 5 to 6 kg. The number of watts required to work such a coil would be about 120.

In the new apparatus the strength of the current is greater than in the Ruhmkorff, on account of the lower resistance of the secondary. This is a very important characteristic for the production of Röntgen rays, since the time of exposure of a photographic plate necessary in any given case is inversely proportional to the strength of the current used to excite the tube.

There is nothing special about the condenser or the interrupter used in the primary circuit. Those which have been found most suitable for the Ruhmkorff coil are employed with the new apparatus.

MM. Rochefort and Wydts have shown their coil at work in comparison with a Ruhmkorff, before the Société des Ingenieurs Civils de France. The tension obtained was about double that of the Ruhmkorff, and the remarkable density of the spark showed that the strength of the current in the secondary must have been very high.

THE TELEGRAPH TROUBLES.

The Clerks' Point of View.

By CHAS. H. GARLAND.

(*Continued from page* 96.)

More than a century ago Adam Smith wrote in his "Wealth of Nations" a striking passage upon the nature of wages. "The wages of labour are the encouragement of industry, which, like every other human quality, improves in proportion to the encouragement it receives." Although it is only recently that such views have triumphed over the time-worn doctrine of the economy of low wages, the trend of modern thought and modern industrial progress is more and more in the direction of a recognition of the economy of high wages. "If you want a thing well done you must expect to pay for it" is a popular way of expressing the traditional belief in the efficacy of good treatment to ensure good work. All the best authority in labour matters leans towards the view expressed by Mr. John A. Hobson in his work on "Modern Capitalism." "Every rise in wages, leisure, and in general standard of comfort, will increase the efficiency of labour." Without pushing this view to the point of absurdity, it is easily demonstrable that a well paid contented body of servants is the source of the highest efficiency, and turns out the largest quantity of work. Towards obtaining such a body of servants it is surely the duty of administrative officers in large public departments to strive. The value of willing, efficient work cannot be over-rated in a service so important as the telegraph service. Unless the highest speed and the utmost accuracy are assured the main object of a telegram is lost sight of. The greatest value can be extracted from the expensive trunk lines by placing willing, efficient operators at either end.

When so much depends on the goodwill of the men it is surely to the advantage of the Department—to place it on no higher basis—to secure that goodwill. Yet we find a tendency rather to parsimony, and irritating refusal to listen to all appeals against anomalies. In a matter that so nearly affects the daily life of the men as the supply of their refreshments, complaints seem powerless to produce an effect upon the red-tapish system, and meals have to be taken under conditions which are a source of constant annoyance and indignation. Yet an inexpensive measure of reform would remove the ill-feeling. So with pay and prospects, whatever may be the view of the administrative officers, to the clerks it seems as though always the least generous view is taken of all schemes and scales in the matter of interpretation, and King Red Tape sits enthroned upon a mountain of anomalies with ears quite deaf to all the clamours for sympathy.

The history of the £190 maximum is an illustration of this attitude. Prior to 1881, the scales of pay for telegraph clerks were as follows:—

Senior telegraphists...	...	...	£140 by £5 to £160
1st class	„	...	£100 „ £5 „ £160
2nd class	„	...	£70 „ £5 „ £90
3rd class	„	...	12s., 14s., 16s., a week, then £45 by £5 to £65 per year.

Complaints of "stagnation of promotion and inadequacy of pay" led Mr. Fawcett, who was Postmaster-General at the time, to make a full investigation of the matter and he found these complaints to be justified. He recommended to the Treasury a scale which was subsequently adopted and which abolished some of the classes and left the pay as follows:—

Senior telegraphists...	...	...	£150 by £8 to £190
1st class	„	...	£110 „ £6 „ £140
2nd class	„	...	12s., 14s., 16s., a week, then £45 by £5 to £100 a year.

This revision came into operation in 1881, and it will be seen that the most important change was the raising of the maximum from £160 to £190. This was the improvement which was to meet the "inadequacy of pay." It must also be noted that the whole of the scale was a scale for telegraphists, that is, for operators. No special qualifications were demanded for promotion to the Senior Class, men were advanced into it in the ordinary course as telegraph operators and no one doubted that if he arrived at the maximum of the first class with a good character he would pass automatically into the Senior Class. Long waits at the maxima of the classes, now so common, were not then known. Mr. H. C. Fisher, C.M.G., the Controller of the Central Telegraph Office, who was then, and is now, the chief officer who deals with the advancement of clerks, in a memorandum dated January 10th, 1896, and published as an appendix to the "Minutes of Evidence taken by the Committee on Post Office Establishments," said "Ordinary manipulative ability, combined with regular attendance and good conduct were considered sufficient qualifications for promotion to the Senior Class." This statement of the Controller is important, because it clearly demonstrates the point upon which the whole controversy hinges. Was the whole scale up to £190 a scale for telegraph operators in Mr. Fawcett's intention? As soon as the scheme was applied, and during Mr. Fawcett's administration, it was so regarded. Everybody, clerks and administrative officers alike, believed it to be so. From 1881 to 1892 the scale was so applied by officers who were familiar with Mr. Fawcett and presumably knew and carried out his intentions. Concerning this scale Mr. Fawcett said, in writing to the Treasury, "The rates of pay which I propose are not more than sufficient to afford just and reasonable remuneration to those on whose efficiency and contented service so much of the interests and the convenience of the community depend."

So we had a scale of pay established for telegraph clerks which led, with no great obstacles intervening, from 12s. per week by a slow progress to £190 per year. In a memorandum attached to the papers issued by the Civil Service Commissioners to intending candidates for the post of telegraphist, it was stated that the scale of pay offered "a prospect of obtaining £190." This memorandum was issued with the authorisation of the Postmaster-General. Surely one would have thought that with such a weight of authority and practice behind it, the "prospect of £190" for telegraphists was sufficiently secure. But in 1892 a change came over the scene. Mr. Raikes had previously, by an obvious slip of the tongue, described the Senior Class of Telegraphists as a "moribund class," and had sedulously denied having said it. Suddenly, and without notice, a special qualification was demanded over and above "manipulative ability" for promotion to the Senior Class. A technical examination requiring considerable study in leisure time was set and made, not qualifying, but in a limited degree competitive. At the same time the trend of departmental utterances was to the effect that the Senior Class was a "superior appointment," requiring special qualifications. And in 1894, in a Return prepared for Mr. Provand, M.P., we find them wrested from the place which they had hitherto so honourably filled among the "general body" in all official returns. Now they were treated and classed as "supervisors." So at last the Senior Class as a class of telegraphists had passed the moribund stage, and from its ashes has sprung, phœnix-like, a new class of supervisors who per-

formed no supervising duties. Protests and petitions were useless. It was represented that to ask of a man well advanced in years and well up in all the duties he was required to perform, to set about theoretical study in order to secure promotion, was a terrible and unjustifiable hardship. Throughout the Tweedmouth Commission's sittings the protest was pressed, but to no purpose, and £160 per year, which Mr. Fawcett had found inadequate in 1881, was declared to be a sufficient reward for the duties of a telegraphist.

Simultaneously with this change in the definition of the Senior Class, an alteration occurred in the ratio it bore to the general body. As a class of telegraphists it had maintained a relation of 1 to about 7·5 to the classes below. But upon the new definition the basis of calculation was altered and the ratio became and has been maintained at about 1 to 10·5. The following table will illustrate the alteration of ratio:—

Date.	No. of seniors.	No. of 1st and 2nd Class.	Proportion of general staff to each senior appointment.
1881	126	966	7·66
1886	161	1,224	6·60
1888	175	1,321	7·54
1890	219	1,590	7·26
1892	170	1,740	10·23
1897	172	1,870	10·87

It will thus be seen that quite apart from the difficulty of the technical examination there was, and is, a lesser chance of advancement to the Senior Class than existed from 1881 to 1892.

The fight against the change in the Senior Class appellation, qualifications and duties was waged throughout last year, and at last, at the conference between the Postmaster-General (the Duke of Norfolk), Mr. Hanbury (Secretary to the Treasury) and a number of M.P.'s, which was held in August, 1897, at the House of Commons, I was able, with the aid of Sir Albert Rollitt, M.P., to argue the matter upon the basis of a "breach of contract." This was the sole basis then taken up. As a result the technical examination was abolished, but the words in which this act of reparation was couched are instructive and typical, "The Postmaster-General and Mr. Hanbury are struck with the consideration that it (the technical examination) may in certain cases operate to bar the advancement of an officer who—though in other respects a skilled operator and efficient servant of the department—may not possess the requisite technical knowledge required for an examination on purely technical subjects. They have therefore decided to abolish this rule, &c., &c."—*Post Office Circular, No.* 1,216, *August* 10*th*, 1897.

So the technical examination was abolished, but the proportion of seniors to the lower classes is still less than before 1892.

With the fall of the technical examination, our contention that the scale to £190 was an operators' scale was in effect conceded. What is now our position on the matter? This is not the place to discuss the admitted evils of classification. Suffice it to say that we had contended before the Tweedmouth Committee for the abolition of classification, on the ground that it was a system full of evils, and this contention had been admitted by the Committee, in its report, to be justified. Sir S. Walpole was one of the five members of that committee. The words of the report run thus:—

"*Promotion and Classification.*—The complaints under this head are threefold. (*a*) The uncertainty and stagnation of promotion within the classes into which the rank and file of the various grades of Post Office servants are divided. (*b*) The slowness and uncertainty of promotion from these classes to the supervising classes; and (*c*) the delay in filling up vacancies.

"We think that on entering the service it is most desirable that a man should be under no uncertainty as to his future career and prospects of promotion. While the present system of classification prevails, the realisation of this ideal must be difficult. For instance, the sorting or telegraph staff consists, as a rule, of so many second class sorters, or sorting clerks, and telegraphists. The duties of the two classes are largely similar, and in those duties many members of each class are equally proficient; yet it is only as vacancies occur in the first class that there is a chance of promotion for men in the second.

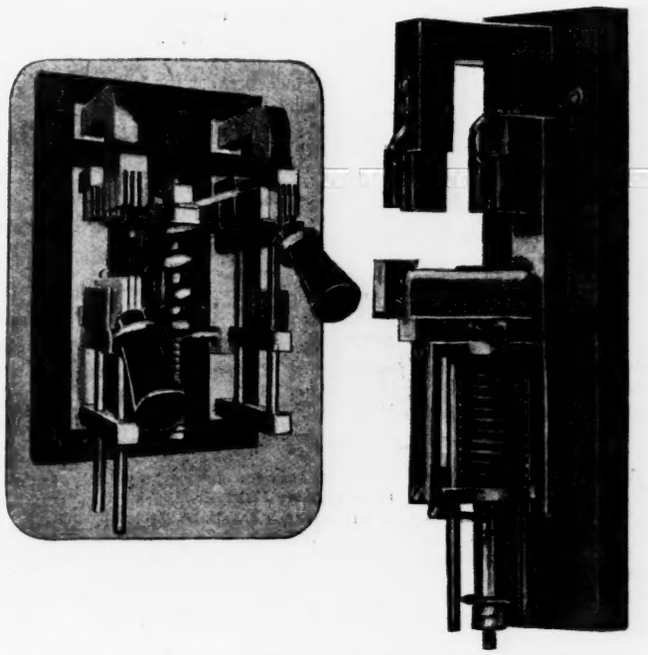
"We therefore recommend that wherever in the case of officers not performing work of supervision such classification exists, it should be abolished, and the officers under certain conditions hereafter to be specified when we deal with the cases of particular classes, should proceed by annual increments from the minimum wage of their class to its maximum."

Telegraph clerks, then, claim that the scale of their class is from a minimum of 12s. weekly to a maximum of £190 per year; that the scale was so intended by Mr. Fawcett, that it was so administered by his officers, and that the demand for any other qualifications than those of manipulative ability and good conduct have been proved to be a violation of their vested rights in this scale. All the evils of classification which led to its condemnation by Lord Tweedmouth's Committee exist in the retained classification now in force, and they demand its abolition. Unless this is done the actual maximum obtainable is only £160, a sum adjudged inadequate by Mr. Fawcett in 1881, and a sum which, under the changed conditions of to-day, is ridiculously insufficient. The prospect of a telegraphist obtaining £190 is less than it was 16 years ago, and so my contention is justified that during a period of progress a large section of public servants have slipped back and have now a lower prospect than in 1881.

(*To be continued.*)

IDEAL CIRCUIT BREAKER.*

A novel circuit breaker has been put on the market by the Ideal Electric Corporation, of New York, the apparatus



Figs. 1 and 3.

differing somewhat from anything yet offered to the public. The movements of the blades, or contact bars, are in a

* New York *Electrical World.*

vertical position, having a reciprocating motion up and down.

The illustration (fig. 1) shows a circuit breaker of the double-pole type, each pole working independently of the other, so that if an overload or short circuit should occur, both blades drop simultaneously. After closing one side of the switch, if the overload or short circuit still exists, in attempting to close the other side, the side already closed will instantly and automatically open. By this arrangement it is practically impossible to close the circuit breaker as long as an abnormal amount of current is passing. The most commanding feature of this switch is that at no time during the entire action of opening or closing, does any part protrude more than 6 inches from the face of the switchboard, thereby avoiding the danger of striking the operator, and very often injuring him. A man of ordinary strength can with rapidity and ease close circuit breakers of this type up to 5,000 amperes capacity. All conducting parts are made of hard-drawn copper, and all parts not made of copper are heavily copper plated, the entire switch being highly polished and lacquered.

The switch is self-contained and can be easily mounted on the switchboard, no lining up being necessary.

Fig. 2 shows the template and all the drilling necessary for

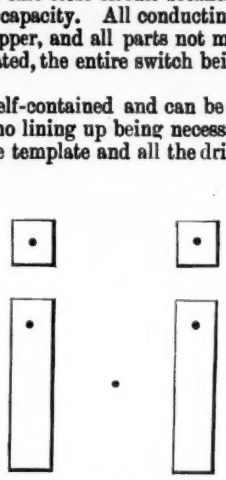


Fig. 2.

a 500-ampere breaker. In the operation of other circuit breakers two large compression springs are commonly used, but in the Ideal there is only one small one, gravity doing the rest. These breakers are also provided with an evenly divided scale, and can be adjusted from 40 per cent. to 50 per cent. overload.

Fig. 3 shows a self-contained single-pole breaker for panel and switchboard work. Only three holes need be drilled in the switchboard to mount the breaker. With the Ideal independent circuit breaker no auxiliary switch is necessary, on account of its independent action.

NEW PATENTS.

[Compiled expressly for this journal by W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.]*

1,258. "An improved cord grip ceiling rose for electrical work." F. W. Heaton and H. Smith. Dated January 17th.

1,290. "Means for augmenting lifting-power by electricity." H. Wolff and W. Brase. Dated January 17th. (*Complete.*)

1,294. "An improved coin-operated telephone instrument for public call." F. J. Clendinnen and G. A. P. Weymouth. Dated January 27th. (*Complete.*)

1,301. "Electric signalling apparatus." F. B. Herzog. Dated January 17th. (*Complete.*)

1,303. "Improvements in magnetic ore separators." G. J. Cream. Dated January 17th.

1,379. "Improvements in electrical insulating conduits and in the method of and apparatus for making same." P. M. Justice. (The Lithosite Manufacturing Company, United States.) Dated January 18th. (*Complete.*)

1,380. "Improvements in the regulation of dynamo-electric machines and motors." F. A. Johnson. Dated January 18th. (*Complete.*)

1,391. "Improvements in electro-magnetic brakes for cars." E. Peckham. Dated January 18th. (*Complete.*)

1,416. "Improvements in telegraphic transmitters." S. Price, W. P. Phillips and R. H. Weiny. Dated January 18th. (*Complete.*)

1,464. "Improvements in and relating to holders for incandescent electric lamps." W. McGeoch. Dated January 19th.

1,465. "Improvements in and relating to moulds for shaping glass globes for gas or electric lights, or like articles." J. Buchanan, Jun. Dated January 19th.

1,489. "An automatic interchangeable electric and mechanical advertiser." H. W. Cox and C. T. Taylor. Dated January 19th.

1,511. "Improvements in terminal fuses." J. G. Dixon. Dated January 19th.

1,535. "Improvements in incandescence electric lamps, and processes for the production thereof." C. A. R. von Welsbach. Dated January 19th.

1,557. "Improved clockwork-operated mechanism for switching electrical current." A. S. Scull. Dated January 20th.

1,564. "Electric striking mechanism for clocks and the like." H. Whidbourne. Dated January 20th.

1,628. "Improvements in and relating to secondary batteries." W. A. Crowdus. Dated January 20th.

1,678. "Improvements in, and connected with, dynamos and electric motors." F. O. Prince. Dated January 21st.

1,686. "Improvements in secondary batteries and in means for combining electric lamps therewith." W. A. Crowdus. Dated January 21st.

1,687. "Improvements in electric signalling apparatus." S. P. Thompson. Dated January 21st.

1,691. "Improvements in electric switches." J. G. Dixon. Dated January 21st.

1,697. "Apparatus for the electrolytic treatment of bleaching liquids." M. Haas. Dated January 21st. (*Complete.*)

1,702. "Improvements in electric batteries." M. Reynard. Dated January 21st.

1,706. "Code telegraphing and circuit-testing apparatus for fire-alarm and other purposes." R. Pearson. Dated January 21st.

1,742. "Improvements in, and relating to, electro-magnetic engines or motors." C. McCallum. Dated January 22nd.

1,787. "Improvements in tools and appliances for bonding the rails of electrical railways, tramways, and the like." P. U. Askham and R. Herd. Dated January 22nd.

1,803. "Improvements in, and relating to, electric arc lamps." L. B. Codd and J. A. Codd. Dated January 22nd.

1,809. "Automatic time switch." E. A. Claremont (c/o Messrs. F. H. Royce & Co., Limited). Dated January 22nd.

1,826. "Improvements in rheostats." H. B. Cutter. Dated January 22nd. (*Complete.*)

1,828. "Improvements relating to the transmission of drawings, hand-writing, and the like by telegraph and telephone." J. Walter. Dated January 22nd.

ELECTRICAL PATENTS OF 1884, EXPIRING IN FEBRUARY, 1898.

We are informed by Messrs. W. P. Thompson & Co. that about 95 applications for electrical patents were filed in the month of February, 1884. Of these some were never completed, and those that were only three have been maintained to run their full length of term, viz., 14 years, and being of some interest we give short abstracts of them below:—

2,858. "Improvements in means for producing and utilising electric currents in secondary circuits." L. Gaulard. Dated February 6th, 1884. The induction coils consist of a round or flat primary conductor surrounded by a number of conductors connected in parallel forming the secondary conductor. The compound conductor thus formed is wound upon a bobbin which may have an iron core. The secondary coils may be grouped in various ways by suitable switches according to the requirements of the system. 5 claims.

3,034. "An improvement in apparatus for electrically controlling railway signals." C. Hodgson. Dated February 9th, 1884. Relates to electrically controlled railway signals and consists of interposing between a signal and its motor, a sway beam or its equivalent, one end of which is worked by the motor, the middle of which is connected to the signal, and the other end of which is either held stationary or is left free as determined by an electro-magnet excited by a current transmitted or brought into action from a distance. 2 claims.

4,025. "Improvements in the manufacture of electrical conductors for telephonic or other purposes." E. T. Trueman. Dated February 27th, 1884. Two or more wires are wound spirally round a hard core (of insulated wire, hemp, India-rubber, &c.). The whole is then passed through a gutta-percha covering machine. The core or the wires of the core may be first taped with insulating tape. After leaving the machine the cable may be passed into water containing plumbago finely powdered, which impregnates the surface forming a double surface. 4 claims.